GRAPHIC GEOGRAPHY

REGIONS AND MEN

by

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INTRODUCTION

This book has been written to further the geography studies of senior pupils in secondary schools. At the same time it will be found to contain useful reference material for certain aspects of junior work.

Prominence has been given to the economic geography of man's activities with just such emphasis on the physical side as should lead to a fuller appreciation of them.

The method of approach is not new. It is claimed, nevertheless, that not only are many of the maps particularly useful from a teaching point of view, but that stress has been laid on the closer relationship which should exist between them and the textual material. In this way the map takes its proper place in becoming basic to geography work in schools. In order to help in this direction the sketches and their related text have been kept as close together as possible in the layout of the book.

The treatment is broad and not too technical in either subject matter or terminology. At the same time similar topics have been approached in different ways so as to give added interest and variety to them.

The use of a tabulated form of text is intended to help in the logical development of material and to show the relative importance of the various geographical aspects of each subject selected for study. This method should not be regarded as a model for all types of written exercises.

The maps will be seen to vary from those of a more complicated nature, which can be made the basis of class discussions, to simple line drawings, which pupils may well use in their own studies. The method of using different kinds of shadings, a scale, and good descriptive titles is one to be followed to advantage.

The book is by no means intended to be exhaustive, as it is the firm belief of the authors from long experience that really good geography studies can be made only with the effective and continued use of a reference library. To that end a short list of standard texts, periodicals and atlases used by the writers in their own classwork is included here.

The complete course is covered in this book dealing with secondary industries, cities, regional studies and conservation, and its companion volume, *The Rural Scene*.

For assistance in gleaning information we wish to thank the Departments of Agriculture and of Mines, New South Wales, the United Kingdom Information Bureau, the Cumberland County Council, and the United States Information Library. Our thanks are due also to Mr G. W. Muir, of Teachers' College, Sydney, for his help in reading and checking the manuscript and the maps.

E. F.
B. R.

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LIST OF MAPS

1

PROCESSING INDUSTRIES

In discussing the activities of peoples living in a community like our own, we usually speak of primary, secondary and tertiary occupations. This is a rather loose and arbitrary classification, but it helps to clarify discussion on the activities of communities. In this book the terms are used thus:

1. Primary industries are those concerned with obtaining foodstuffs and raw materials from the earth. They include such activities as grazing, agricultural farming, lumbering, fishing and mining. The products obtained from them are sometimes sold direct as consumer goods (as with fish, fruit, vegetables, etc.); but more often they are treated by one or other of the secondary or manufacturing industries before passing to the consumer.

2. Secondary industries are concerned with the treatment and manufacture of the materials obtained from the primary industries. They may be divided roughly into three types:

(*a*) Processing industries, which transform the materials from the primary group into foodstuffs, or consumer goods, or material for further treatment in other industries. This group includes butter factories, flour mills, canneries, saw mills, sugar mills and refineries, smelting plants and steel mills.

(*b*) Fabricating industries, which, in the main, take the products from the processing industries and convert them into finished consumer goods. Some examples would be clothing factories; furniture factories; industrial plants producing steel goods such as motor cars, locomotives, refrigerators, household goods and machine-shop products; paper mills turning wood-pulp into paper; printing works; boot and shoe factories and so on. These industries are carried on in the factory buildings which form such an important part of the pattern of modern cities.

(*c*) Constructional industries. Here we have a group of activities concerned with the making of houses, bridges, roads and the factory buildings used by other secondary industries.

Would shipbuilding be a constructional or a fabricating industry?

3. Tertiary industries are concerned with performing some service to the community; hence the title sometimes used: Service Industry Group. It includes governmental administration, communication and transport, wholesale and retail shopping services, amusements and entertainment, head-office management of big trading firms, banks and insurance, professional services (medical, legal, teaching etc.) and personal services such as dry-cleaning and hairdressing. In a large community, this section includes the greatest number of the employed population. It is almost absent among the subsistence peoples. In a sense it may be regarded as a measure of the technological development of a people.

Figure 1 illustrates some "processing" features connected with the processing of woollen materials in the Bradford-Leeds area, England.

The general method of treatment is shown at the left of the chart, while the details of the main activities and associated activities are indicated in the central and right-hand columns.

Note the following points:

(*a*) The number and type of activities connected with bringing the raw materials to the manufacturing centre.

(*b*) The significant stages of manufacture, shown under the heading of processing. It is necessary to know these to understand their relation to other industries (such as chemicals, power and machinery), leading to integration of activities within the manufacturing area.

(*c*) The destination of the finished product. This gives the general link between the processing and fabricating industries.

(*d*) The importance of various forms of transport in both the collection and distribution of the products.

Many towns and cities which are trading and commercial centres or manufacturing centres for chemicals, power and machinery, are closely connected with the processing industry, even though they do not actually produce woollen and worsted materials. You may therefore begin to understand something of the interdependence of activities within a geographical region that leads the geographer to talk of such things as satellite centres to a main industrial city and of integration among these centres and the main processing areas.

GENERALISED CHART OF THE ACTIVITIES CONNECTED WITH WOOLLEN MANUFACTURES IN THE BRADFORD-LEEDS AREA

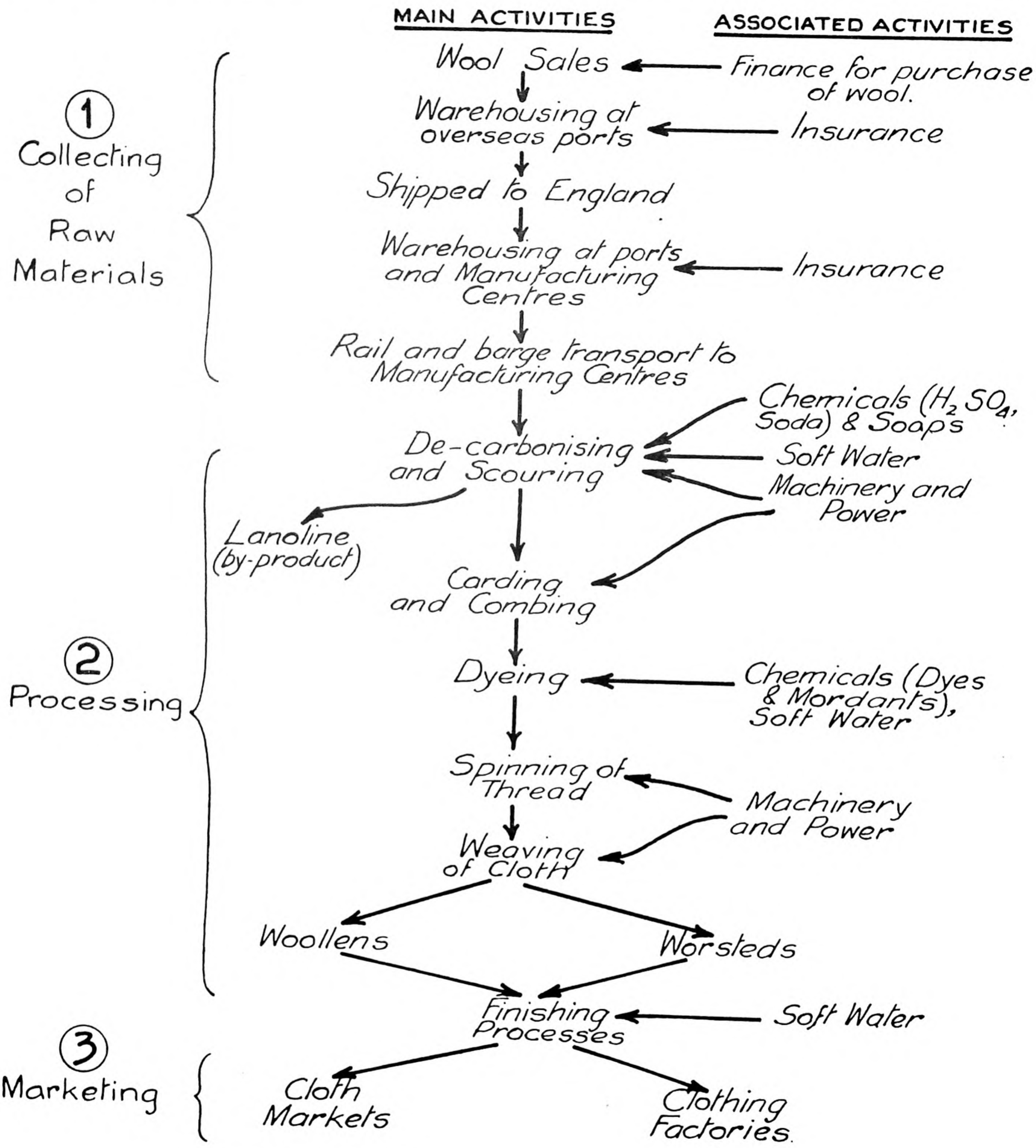


FIG. 1: Activities connected with woollen manufactures at Bradford — Leeds.

LEEDS-BRADFORD WOOLLEN INDUSTRY

Historical factors: localisation of the woollen industry (1350-1550). From a study of Figure 2 it can be seen how various factors operated from the fourteenth century to the sixteenth to localise the woollen industry in the Yorkshire region.

There was an abundance of wool from the grazing and shearing of the sheep on the uplands where suitable short grasses grew. Labour supplies came mainly from the abbeys and adjacent peasantry, who, after the initial treatment of the wool by washing in the valley streams and spinning, transported it mainly to York for weaving. In those times York was an important market, bridge and manufacturing town: as early as 1377 there were over 800 looms in York. Smaller townships and markets had not developed sufficiently to be of significance, and trade in woollen goods was largely local.

Migration of the woollen industry to the hill-stream villages. Between 1500 and 1800 the development of simple machinery worked by water power caused the industry to migrate to the valleys of the Pennines. Here the speed of the water not only produced the necessary power, but its pure and soft qualities, gained by filtration through the Millstone Grits, made it especially suitable for washing fleeces and dyeing the woven cloth. As a result, mills of the industry at this time were concentrated in many hill-stream villages along the upper courses of such streams as the Wharfe, Aire, Calder and Dearne. Of these the Aire and Calder valleys gradually became the most important for the manufacture of both woollen and linen cloths, with Leeds, Wakefield and Bradford the principal markets for the export trade built up. This particular localisation led to a rapid decline in the importance of York, which by the middle of the sixteenth century could only boast some four looms. An important additional factor in this particular development was the introduction of a canal system to join the lower course of the Aire with the Humber, with its townships of Goole, Hull and other outside markets.

Centralisation of the woollen industry in factories on the coalfields (1800-1950). The next and final stage in the centralisation of the woollen industry in Yorkshire was the development of steam power associated with new inventions in textile manufacture and the opening up of the coalfields. This led to a decline of the water-power mills of the upland valleys and a concentration of the industry in factories situated at nodal points like Leeds, Bradford, Huddersfield, Halifax and Dewsbury, which became the principal centres of manufacture. Labour continued to move into these centres from the agricultural areas, but highly skilled tradesmen were needed to cope with the ever-improving and increasingly complicated processes of textile production.

Today the development of satellite towns to those mentioned, together with the spread of those cities, has resulted in the appearance of a great conurbation of some forty towns covering both the Aire and Calder valleys.

Finally, the specialisation of processes in the industry (see pages 13 and 14), the world demand for woollen goods and the import of raw wool from overseas—especially from Australia and New Zealand—led to the development of an important railway and water pattern of communication. As a result Hull became a thriving and busy port. Other ports which assisted materially with the trade of Yorkshire were Liverpool and London.

Average wool imports (1935-39). The first general conclusion to be reached from a study of Figure 3 is that Hull is not the major port of entry for raw wool into the Yorkshire woollens district. London and Liverpool are much more important because they are the terminal ports for many of the shipping companies whose boats carry wool from overseas. The wool is off-loaded at the terminal ports and sent by rail to Yorkshire. In actual fact Yorkshire consumes practically all of England's imported wool, the other woollens districts consuming mainly local wools.

Other notable points are:

(*a*) The enormous amount of raw wool which comes into the country to supplement local supplies. In 1935-39 local supplies were about half the amount imported.

(*b*) The important place of Australia with its fine quality wools as a supplier of material for the high-grade cloths for which Yorkshire is world-famous.

(*c*) The relatively small amounts arriving from countries other than Australia. These wools are used principally in the carpet manufacturing trade.

Millstone Grits and textile manufacturing. Figure 4 shows in a generalised manner how certain geographic circumstances have assisted in the localisation of textile manufacturing in both Lancashire and Yorkshire.

A study of the two drawings will reveal the extent and nature of the Pennine uplands in relation to the two regions. It will be observed:

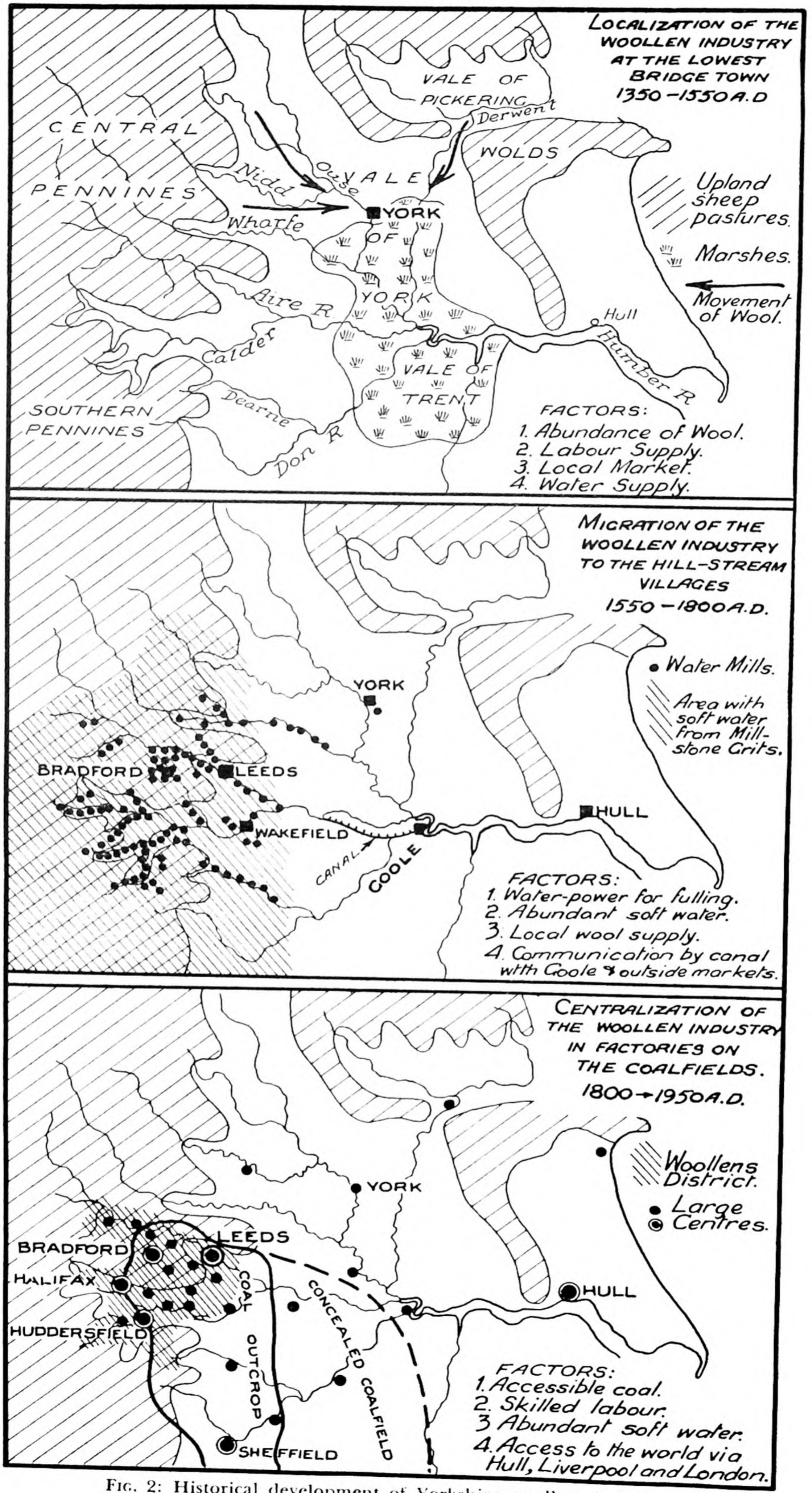


FIG. 2: Historical development of Yorkshire woollens industry.

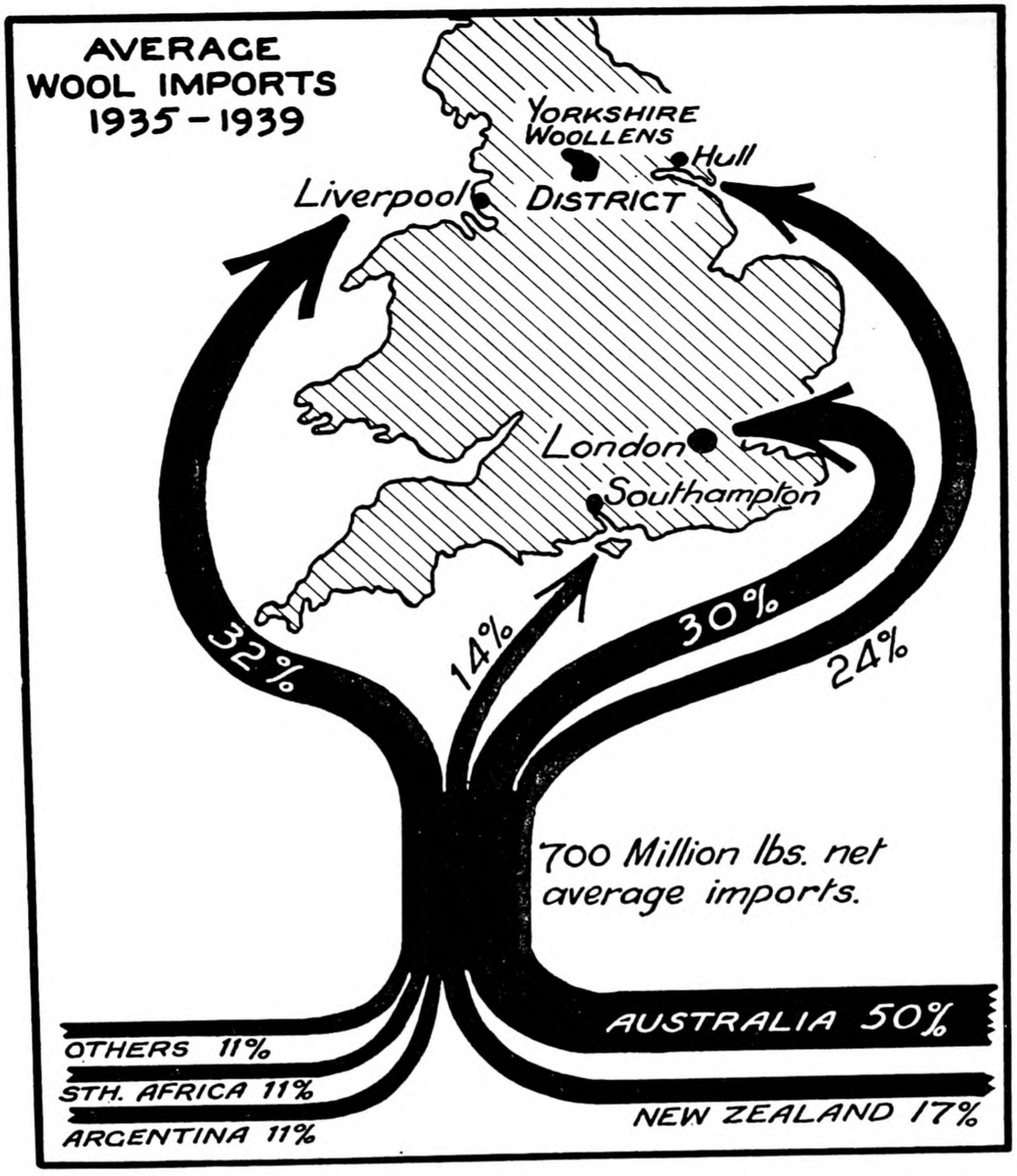


FIG. 3: Source and destination of British imports of raw wool.

1. They act as a relatively broad low watershed and an important determinant of the drainage systems on the east and west. In addition, the surface covering over most of the moors is peat, which absorbs much of the rain and releases it to the streams as a steady flow from springs.

2. The streams rise and for the most part flow in the upper valleys through the Millstone Grits. These consist of sandstones which act as excellent filters and produce "soft" water, i.e. water free from any large amounts of calcium or magnesium. For this reason the respective locations and areas of the grits and limestones are especially important. Not only are the latter avoided, but there is also a wider spread of textile industries southward in Lancashire than in Yorkshire because of the extension of the sandstones in relation to the Pennine water supply. In other words, it is not only a question of the amount of water available to certain manufactures, but also of its quality. If the fortunate geographic circumstance just outlined did not obtain as it does here, tremendous sums would have to be spent to "soften" water chemically where other advantages of location outweigh the cost of such a practice.

3. The location and pattern of the coalfields assist the industry. With few exceptions most of the manufacturing centres are on or very close to the fields, e.g. Manchester, which is mainly a great merchandising centre now. Coal was responsible for the movement of the mills from the water power of the upland valleys and it still retains its economic significance not only as a source of power by the generation of both steam and electricity, but as a source of valuable by-products, notably in dyes. While coal has special re-

lations with the textile industry it is very versatile in its application to a wide variety of associated industries, e.g. the manufacture of processing machinery.

The Yorkshire—West Riding woollens district. For many years now the West Riding has been the most important wool-textile district in all England. Its early dominance was due to factors already mentioned, but access to coal was especially important, since it gave the district a marked advantage over other districts to the south-west and east. Electricity is nowadays another source of power which aids the efficiency of the industries there, with coal adding to its full value by reason of its yield of dyes for the cloth trades.

Within the West Riding itself there are several important geographical aspects of its manufacturing to be noted and Figure 5 makes them clear:

1. The industry as a whole is localised mainly in the upper valleys of the Calder and Aire and so extends well into the Pennine highlands. As a result there are significant relationships with Lancashire as will be demonstrated in later maps herein dealing with the textile industry.

2. There is a particular pattern of the industries themselves and of the specialised phases of wool-textile manufacture; for although both the worsted and woollen trades are widely spread throughout the district certain specialisations have tended to develop.

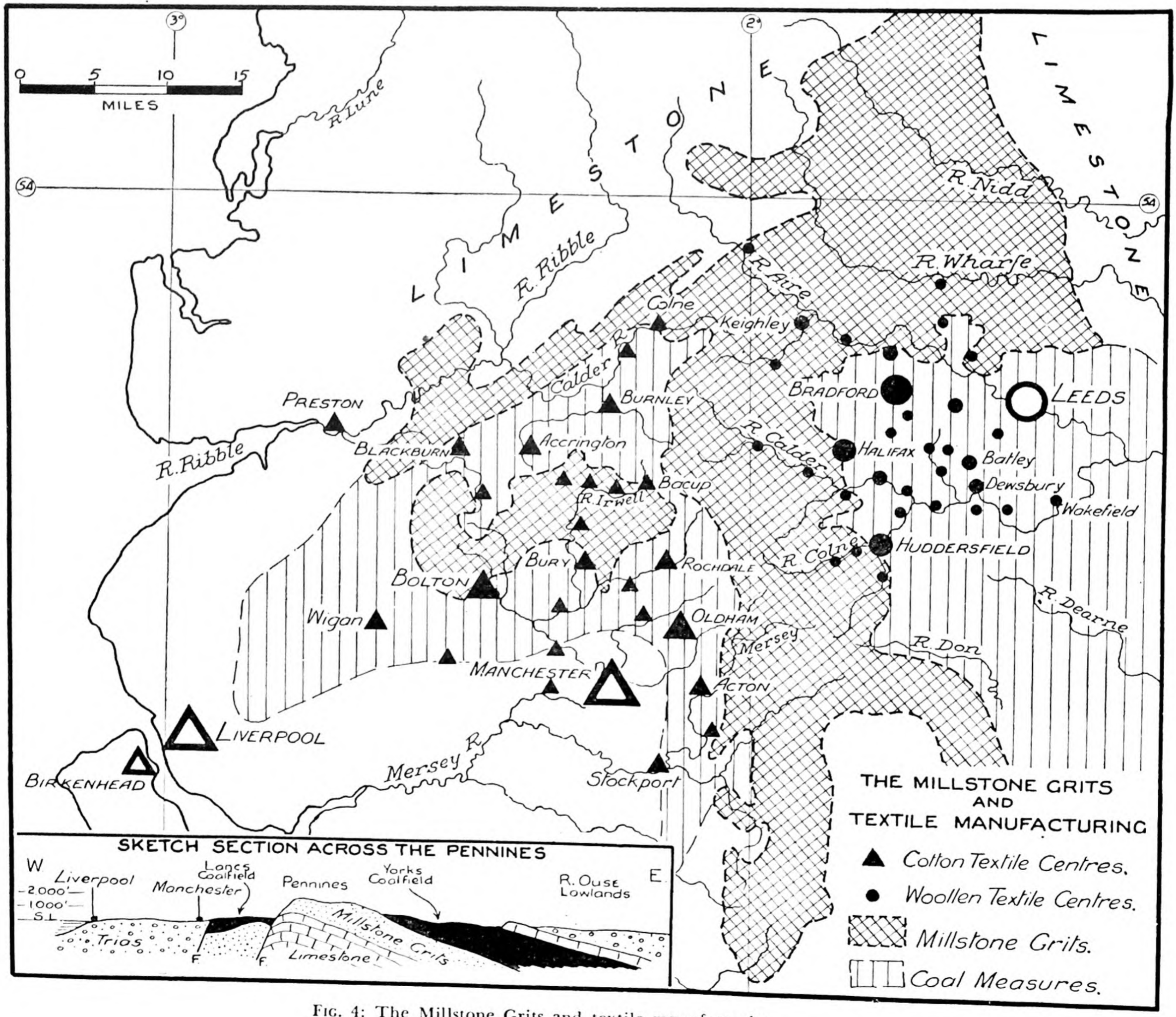


FIG. 4: The Millstone Grits and textile manufacturing.

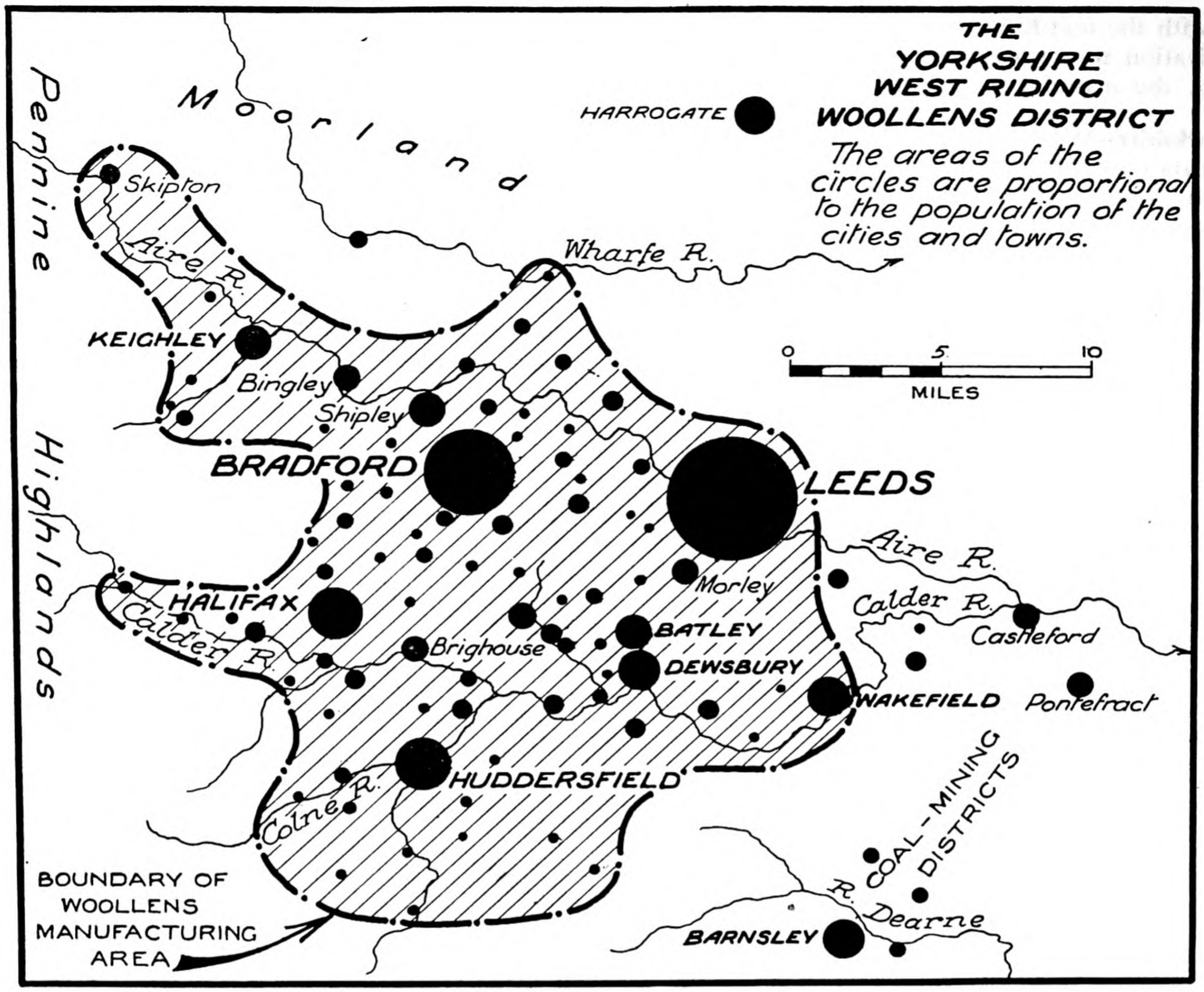


FIG. 5: The distribution of towns and cities in the Yorkshire woollens area.

Thus in areas about Dewsbury and Batley there is a concentration on the manufacture of cheap fabrics (or shoddy) with many firms treating rags to produce new cloth. Blankets, rugs and druggets also figure in their mills. But the worsteds trade is to be found mainly to the west and north in cities like Keighley, Bradford (also yarns), Halifax (heavy woollens) and Huddersfield (serges and tweeds). Wakefield makes yarns and Leeds now puts out only a relatively small amount of woollen goods following upon the movement of the raw wool trade to Bradford. Leeds is now the centre of a vast trade in ready-made clothes.

With respect to specialisation in the actual textile processing, it seems that on the whole the dyeing trades are most in evidence in the middle portions of the Aire and Calder valleys, i.e. in the vicinity of Shipley, Leeds, Bradford and Halifax. In the upper parts of these valleys, spinning and weaving would appear to be equally important, but to the east and south weaving is predominant. In connection with these facts it is worth noting that Huddersfield is important for the quality and designs of its fine cloths, while Bradford has long been famous for its silks, velvets, plushes and worsteds, with a specialisation in alpaca. From this specialisation it can be seen that in the principal towns there is a localisation of processes; they have also developed the manufacture of related groups of fabrics.

4. Observation must be made of some of the important relations between the wool-textile and other industries. For example, Leeds has large iron and steel manufacturing plants, which are concerned mainly with the production of locomotives, railway stock, and machinery used in the woollen industry. It also has interests in leather, chemicals, glass, printing and rayon. Bradford, too, is a great market and administrative centre for the trade, especially at the distributing end. Halifax specialises in carpets. Keighley is an engineering centre, as also are the towns of Huddersfield and Wakefield. The latter is in a large

coal-mining area and makes agricultural implements and chemicals. These few examples help to show that complete adherence to the woollen industry is not as common as might be expected, and the boundary line on the map is a rather arbitrary one and only intended to make a simple division between the West Riding manufacturing district and adjacent areas.

Textile machinery manufacturing. Figure 6 can best be understood by reference to the studies already made of the textile and associated industries of Yorkshire. It should also be examined again after the chapter on Lancashire has been read. Here the following comments may be made:

1. The larger centres shown, their relative importance being indicated by the size of the circles, are mostly the older established townships. These have developed the triple functions of processing, marketing and the making of machinery needed in their own trades and those of the surrounding towns.

2. Each town shown specialises in the equipment for that textile industry for which it has become well known, e.g. Macclesfield and the silk trade, Nottingham and the lace industry and Halifax with its carpet workers.

3. Because of this fact there is a general independence from the other machinery manufacturers of the world. On the other hand, these towns make equipment for overseas export, since they have become so expert and specialised in their various methods.

4. The centres for the sale and marketing of machinery are, in general, the trading centres for the textile trades as a whole, e.g. Manchester and Leeds.

5. An interesting analysis can be made of the various physical and economic factors responsible for machinery manufacture in these particular regions, e.g. access to coal, transport, labour, etc. Historical factors are also important and the drainage pattern here gives a clue to the significance of water to most industries in their development.

FIG. 6: Textile machinery manufacturing centres in Yorkshire and Lancashire. *(After Stamp and Beaver)*

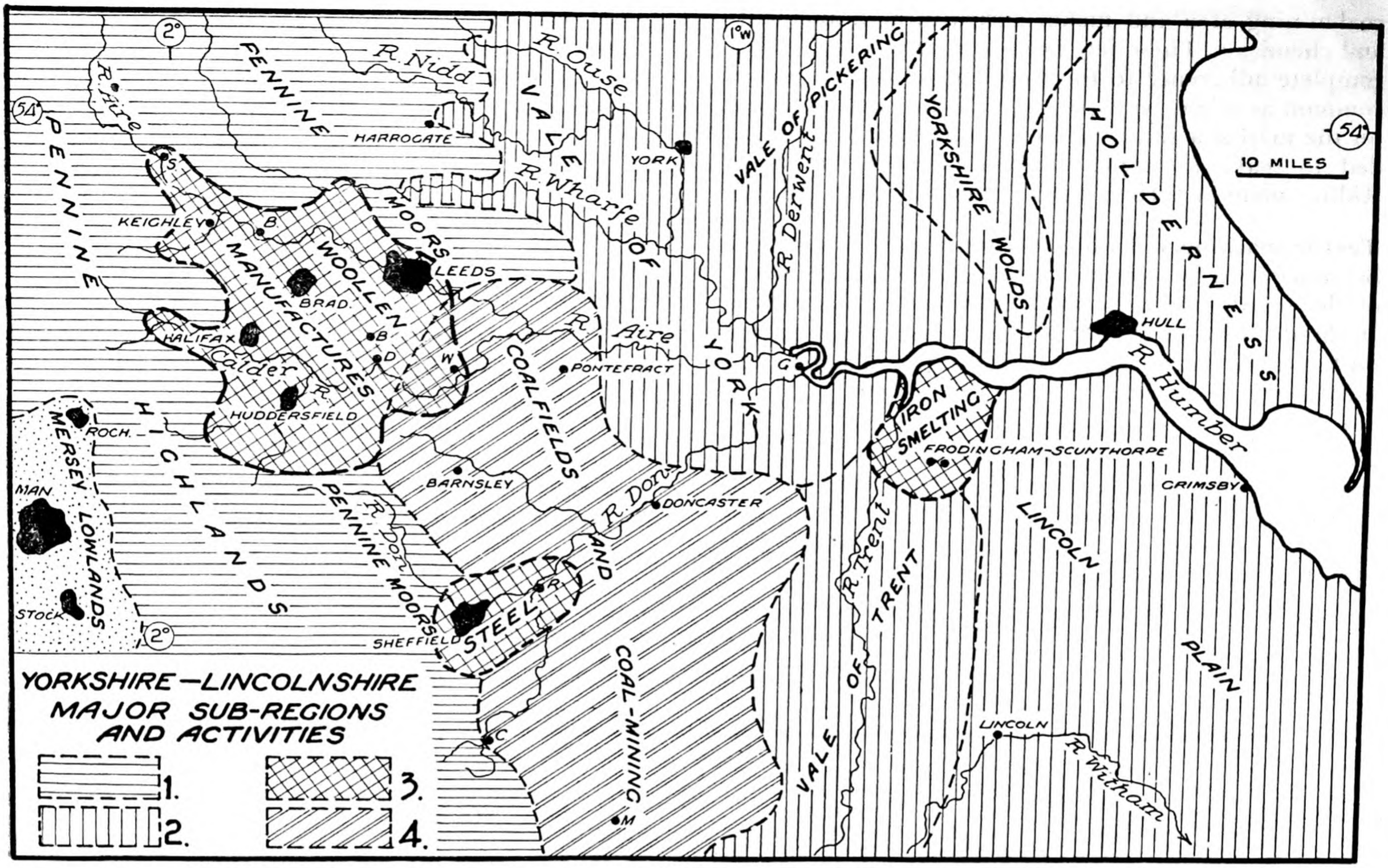


FIG. 7: Major sub-regions and activities in the Yorkshire area. 1. Highland and moorland grazing region (mainly sheep). 2. Lowland arable farming and grazing regions (mainly dairying and meat production). 3. Manufacturing regions. 4. Coal-mining region.

Yorkshire—Lincolnshire (major sub-regions and activities). General. In analysing Figure 7 attention is drawn in the first place to several general features which distinguish the map as a whole.

1. The relatively smaller size of the uplands as contrasted with the lowlands. These were an important factor in the establishment of the woollen industry, and are still devoted to the raising of many sheep.

2. The considerable amount of lowland utilised for arable farming and stock grazing. This region is of special significance as a supplier of foodstuffs to nearby industrialised areas.

3. The special place of ports like Hull and Grimsby as suppliers of fish to supplement other foodstuffs.

4. The extent of the coalfield and its area relationships with the other types of industrial activity.

5. The strongly localised sub-regions of wool and steel manufacturing due to historical influences and an association of water, coal and basic raw materials.

6. The localisation of the iron-smelting industry on the tide-water estuary of the Humber.

7. The location and geographical significance of the drainage scheme, more particularly in its relation to the general pattern of activities here.

8. The strategic position of the sea-gates of Goole, Hull and Grimsby with respect to imports and exports of the region as a whole.

9. The contrasts which can be made between the settlement patterns of each of the sub-regions.

10. The geographical divisions between the Yorkshire-Lincolnshire areas and the Mersey lowlands.

Detail. 1. Highland and moorland grazing region. These are the high, bleak and rainy uplands of the southern Pennines. Consisting of limestone and Millstone Grits, they are not suited to cultivation, the former producing only a thin soil and the latter being covered mostly with peat and heather. Limestone parts do permit the pasturing of stock on the short, crisp grasses which develop there, but the water is hard. The grits are the source of soft water so important for both industrial and domestic uses and it is dammed in the hills above the western towns. On the whole the Pennines have only a small population, but in the valleys which pierce them the farmers raise sheep for mutton and cattle for beef. Because of the local practice of moving stock up and down the highlands for pasturage an interesting form of transhumance is still to be found there.

2. Lowland and arable farming regions. There are several divisions of this sub-region and on these the following short comments may be made:

(*a*) *The Vales of York and Pickering.* The soils here are a mixture of glacial and alluvial deposits and although many areas were once marshland, these have been drained and converted into some of the best areas of arable agriculture in England. Production includes such grain crops as wheat, oats and barley, and root crops of potatoes and sugar beet. Market gardens supply the industrial centres. There are also considerable amounts of pasture land for cattle. The main settlement is the old cathedral town of York, which is now an important rail-junction and market-place.

(*b*) *The Vale of Trent and Lincoln plain.* Arable agriculture is similar to that of the above with some interesting differences. Thus the Trent area specialises in pastures for the fattening of cattle bought elsewhere and the raising of the best hunters in the country. Lincoln is on the edge of the Fens and has extensive tulip cultivation. The city of Lincoln is noted for its magnificent cathedral. It is a market centre and manufactures agricultural machinery for the surrounding farmlands.

(*c*) *Places of less fertility* are Holderness, which is a drained lowland of clays producing wheat and cattle, and the Yorkshire Wolds, the thin chalk and clay soils of which have been carefully cultivated to grow root crops like turnips and to raise sheep.

3. **Manufacturing regions.** Three major types of manufacturing are mapped in Figure 7, but like most industrial centres there is considerable variety within each of these.

(*a*) *Woollen manufactures.* As pointed out in comments on Figure 2, there is an interesting historical background to this particular activity. Its present localisation is due, of course, to the presence of water and coal, to access to imported raw materials by ports, and to good transport, which last also assists in the outward movement of finished goods to world markets. The Aire and Calder valleys are the two most important sections; within these a certain specialisation occurs, but not as in Lancashire where there is a division of spinning and weaving towns. For example, Keighley is a producer of worsteds and Halifax of carpets, whilst Dewsbury makes textile goods from old materials. Leeds not only makes woollen goods but has an enormous production of ready-made clothes. Bradford is best known as a wool market and the main centre of worsted manufacture. In almost all these cities, textile machinery making and industries ancillary to the cloth trade are common.

(*b*) *Steel.* Here in the valley of the Don a combination of local factors like water, iron ore, limestone and grits (for sharpening) and coal helped to establish an important centre of the English iron and steel trade. Now much of the raw material is imported and there is a concentration on a secondary processing of steel goods like cutlery, armaments, railway bogies and textile looms. Great technical skill has been built up in these trades and the products are amongst the world's best. Sheffield is the chief city in the midst of a typical ugly industrial district.

(*c*) *Iron smelting.* The siting of the smelting industries here is bound up with the existence of local self-fluxing ores, nearby coal for fuel, and ease of transport for bulk materials. Added to that there are available certain valuable sand fluxes, and, of course, big markets in such places of constructional and machine manufacturing as Lancashire and Yorkshire itself. This sub-region is regarded as one of those areas which have great possibilities in English industry. The two main towns are Frodringham and Scunthorpe.

4. **Coal-mining region.** The Yorkshire field is one of the largest in England, being over 60 miles long and up to 20 miles wide. The coal is of excellent quality for both domestic and industrial purposes and is easily worked. It has special importance for the industrial areas already discussed; but it is no longer confined to a local consumption since export is available now that mines are open nearer Hull, that is, about the town of Doncaster. Here, too, are railway workshops.

5. **The main ports.** The part played by ports is no small one. Hull imports an enormous amount of foodstuffs for the inland industrial regions and handles their manufactured goods as exports, e.g. woollen and steel goods, coal and machinery. Since it is in a tidal estuary, wet docks accommodate overseas and coastal vessels. Here, too, the trawling industry had a start. Grimsby later proved a better spot for landing the North Sea fish and despatching them to market by special fast trains. Goole is mainly interested in the coastal trade of coal and foodstuffs.

3

LEAD-ZINC AND BROKEN HILL

Generalised chart of activities associated with lead-zinc-silver mining at Broken Hill. Figure 8 is a diagrammatic representation of the general stages of the processing of metalliferous ores from the mines at Broken Hill and the associated industries and transport.

At the first stage, in order to save freight expenses, the ore (containing some 10 to 20 per cent lead and zinc compounds) is put through a preliminary concentrating process at the mines themselves. Each of these has a huge treatment plant; on reaching the surface in skips the ore is put through crushing plants, which reduce it to a fine powder. It is then concentrated by water separation over jig tables, and finally by the flotation process. In this, crude eucalyptus oil is mixed with water to float off the particles of lead and zinc sulphide. It is these concentrates which are then passed on by rail to the smelters at Port Pirie. Incidentally the useless residue from the above processing is stacked on the surface in characteristic mine

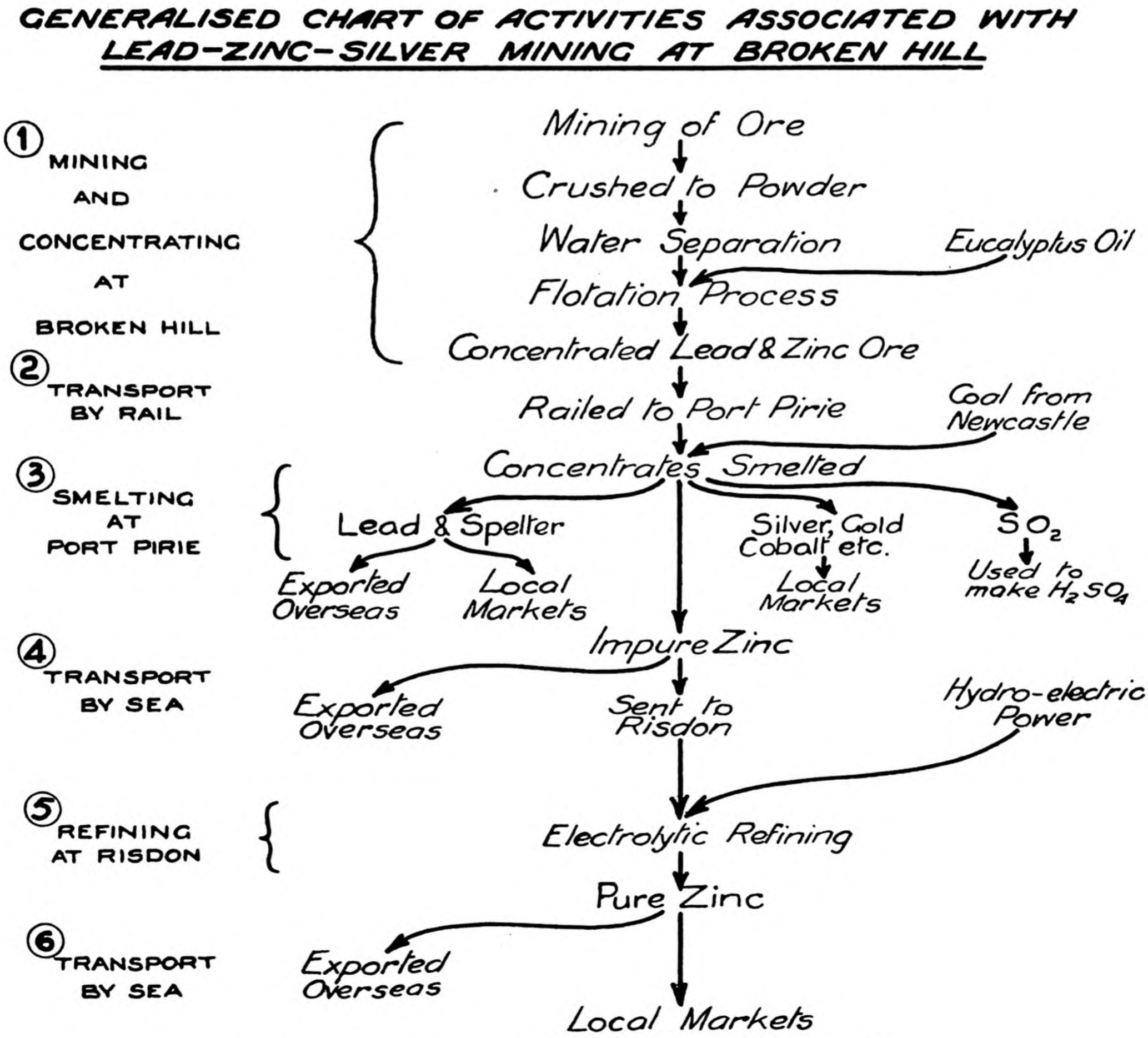


FIG. 8: Broken Hill: activities associated with lead-zinc-silver mining.

dumps or sent back underground to fill worked-out stopes.

The site for Port Pirie was chosen because it was the nearest port to Broken Hill and could obtain supplies of coal from Newcastle by sea at a reasonable cost. At the huge Port Pirie plant the second stage of treatment involves putting the concentrate through a series of smelters which finally produce lead and silver ingots and almost pure zinc ingots. These, together with other by-products, find ready local or overseas markets. Some of the zinc is forwarded to Risdon in Tasmania, where a large electrolytic plant treats it to give metal which is 99.99 per cent pure. Important factors in the setting-up of the works at Risdon were a deep water frontage and the availability of cheap electricity from the Waddamana scheme.

Final stages are concerned with the use of the zinc for local or overseas demands.

Attention is drawn to the relationship between Figure 8 and Figure 11, which shows the industrial and trade relationships of Broken Hill to the States and major settlements of south-east Australia.

1. Broken Hill is in comparative isolation, being in a region which does not lend itself to intensive occupation of an arable or pastoral agricultural character. This is further emphasised by the lack of large towns near by.

Because of that the rail lines shown are significant, forming important links in the handling of such raw materials and other products closely associated with the metalliferous mining industry, as well as consumer goods and food supplies. Such trade is predominantly with the closer industrial ports, e.g. Port Pirie, and with Adelaide in South Australia. The map does not show all rail lines, but indicates the airlines which are becoming increasingly important in Broken Hill communications.

2. The city of Broken Hill today boasts a population of some 27,000 and has many fine modern buildings, commercial, administrative and educational, as well as private homes. There are also excellent amenities in the form of parks, gardens, playing fields and swimming pools. The general street plan is a rectangular one. The two-mile long ridge with the mines on it runs through the heart of the city, dividing it into two sections. One of the main problems has been to obtain a good water supply. Earlier dams proved inadequate and it was often found necessary to bring water by rail from Menindee on the Darling River to the east. Plans have been completed for the construction of a reservoir on that river and the piping of the water 70 miles from there to the city.

3. With the gradual exhaustion of ores in the Broken Hill Proprietary mines, that company decided to invest its funds in iron and steel works. These were established at Newcastle and subsequently at Port Kembla and were the beginning of Australia's greatest industrial undertaking.

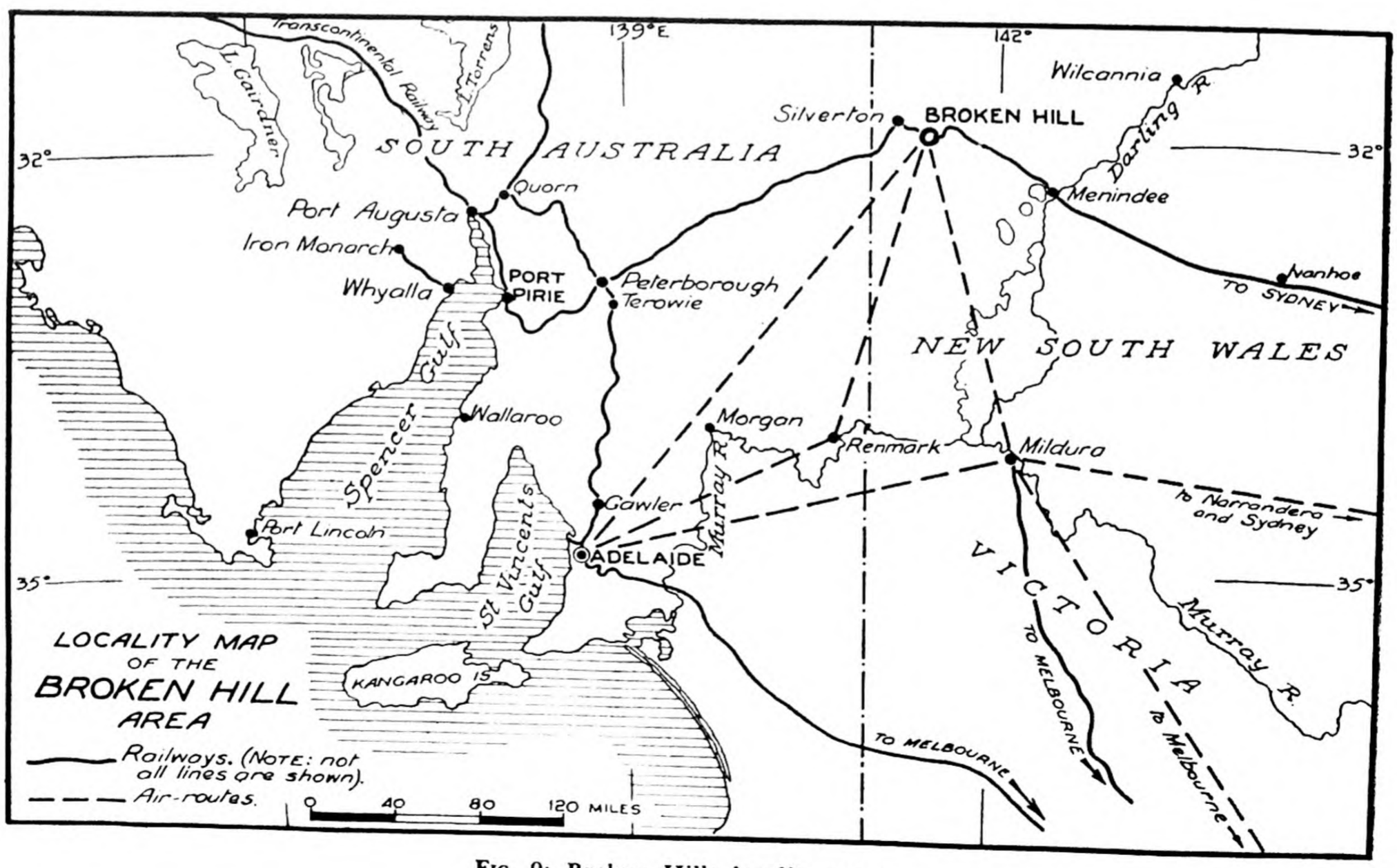


FIG. 9: Broken Hill: locality map.

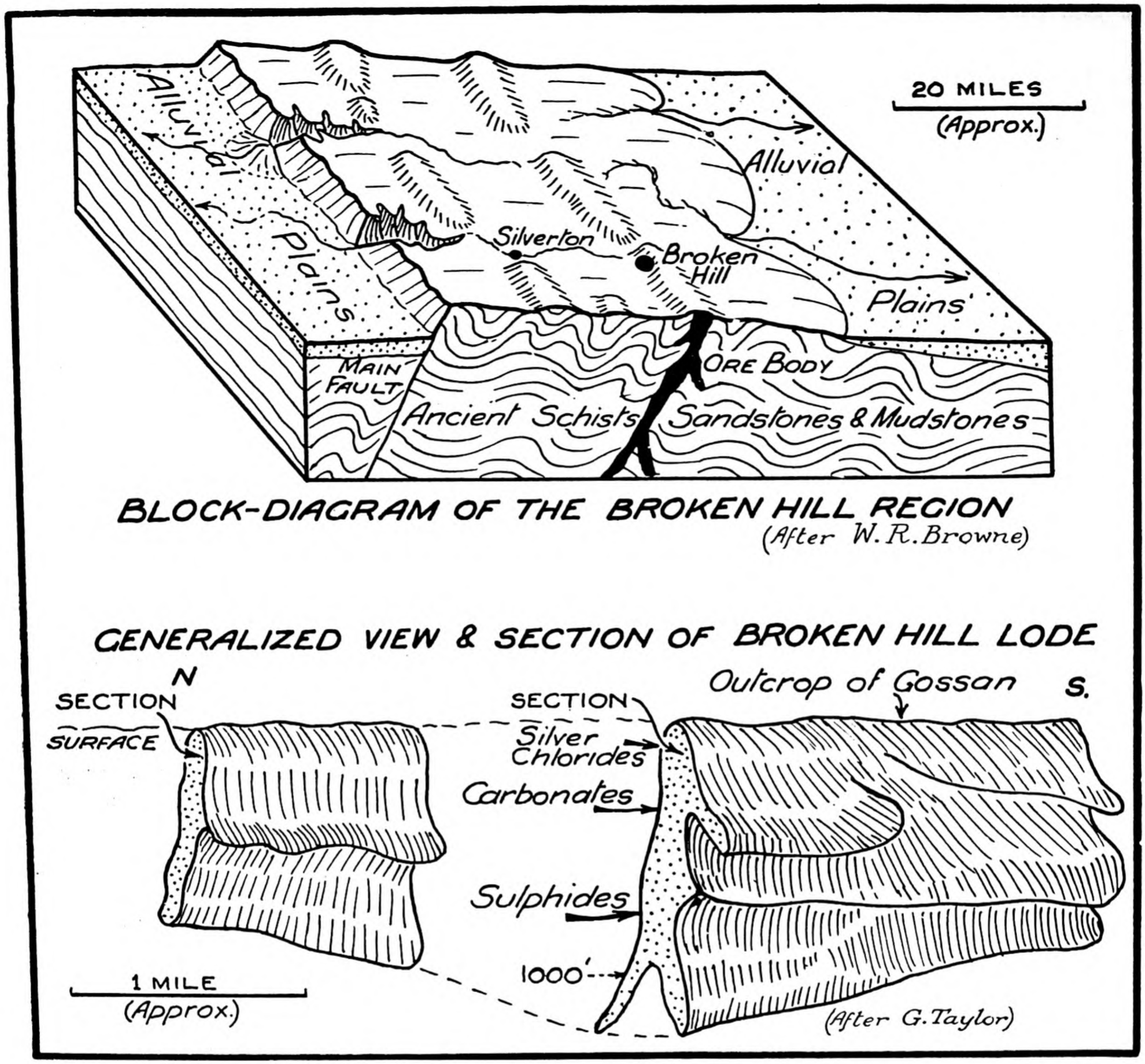


FIG. 10: Broken Hill: block diagrams of the area and ore body.

Block diagram of the Broken Hill region. Figure 10 shows how the narrow ore body is actually situated and appears as a surface outcrop. It is contained in an inlier of ancient rocks around which is an expanse of alluvium and sand. The folded rocks consist of schists, sandstones and mudstones across the folded bedding planes of which the ore body has been intruded. The 900-foot throw of the fault to the west left the area raised above the surrounding country and then the streams so formed carried away the surface material and exposed the lode at some places 150 feet above the surrounding plateau. This, today, consists of rugged, rocky residual ridges and hills with sandy watercourses and broad rolling country between them. Originally the region carried a dense coverage of semi-desert scrub.

Generalised view and section of the Broken Hill lode. The lode itself consists of a huge longitudinal arch with its apex forming the highest point along the ridge and dipping at both ends below the alluvium. The outcrop is about $3\frac{1}{2}$ miles long and up to 200 feet wide, while its greatest depth as shown on this sketch is over 1,000 feet. Two special features to be noted are the irregular shape of the ore body and the variation of ores with depth. Thus silver is found at the top and lead and zinc towards the bottom. Since the silver became exhausted as mining proceeded, lead and zinc soon became more important. At present the more valuable minerals of the upper sections are being worked out and production costs are becoming higher. These costs are influenced by the lode shape and the weakness of the enclosing rock.

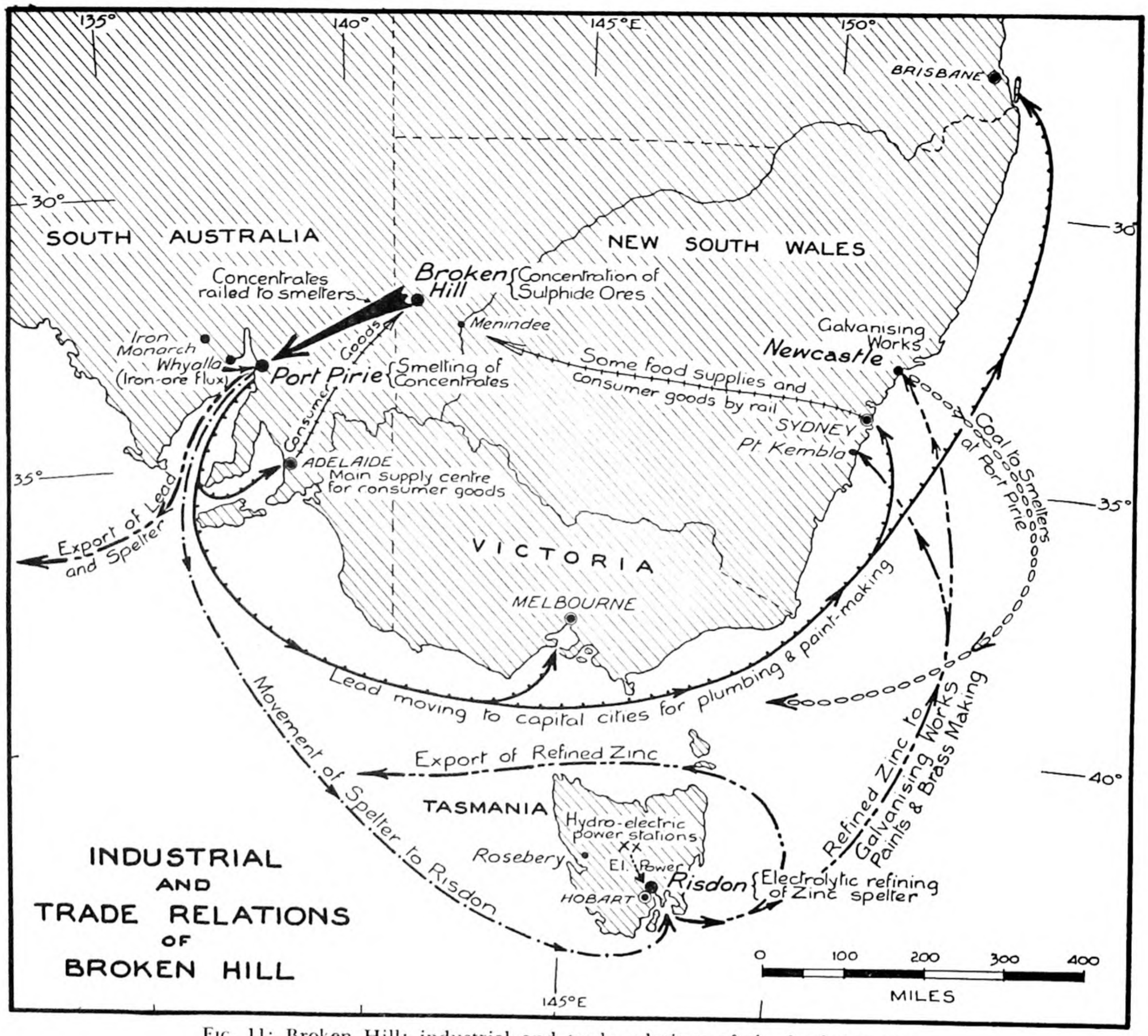


FIG. 11: Broken Hill: industrial and trade relations of the lead-zinc area.

Overhead stoping methods of mining were used from the outset and waste materials were commonly used for filling the enormous cavities left after the extraction of ore. Much timbering was also required.

An extensive open-cut was made along the centre of the lode to a depth of about 300 feet, which literally removed all ore in that section. The oxidised ores were easily won with pick and shovel, but as the harder sulphides were met the use of explosives was required.

A rough estimate of the original reserve at Broken Hill has been placed at about 52 million tons of ore containing about eight million tons of lead, six million tons of zinc and over 300 million ounces of silver. The annual return prior to 1946 was something like £5,000,000; but since then it has risen to about £20,000,000.

Industrial and trade relations of Broken Hill. Figure 11 is intended as a diagram-map summation of much that has already been stated in relation to Broken Hill metalliferous mining. At the same time attention is drawn to the dependence of certain export and refining centres on the immediate availability of ores from the mines, e.g. Port Pirie and Risdon. In turn the former also looks to Whyalla for fluxes and Newcastle for coal. Then there are the demand for and uses of the refined minerals from Port Pirie and Risdon, e.g. lead for the capital cities for plumbing and paint making, and zinc for galvanising and brass making.

Not the least significant trade relations are those of Broken Hill with the capital cities in order to obtain food and consumer goods. As already pointed out Adelaide is of special significance in this connection. External exports are of course also important, more particularly with British and European industries (e.g. zinc to South Wales).

This map and its associated diagrams should be studied carefully for comparisons and contrasts with the metalliferous minerals industries in South Wales (see pages 36 to 41).

4

STEEL-PROCESSING AND U.S.A. PROCESSING PLANTS

Figure 12 is a diagrammatic summary of the stages in the processing of iron ore to make steel. In reading the chart note that the main steps are printed at the right-hand side and that they are further emphasised by the use of thick arrows. You should get a clear picture of these steps and products first, and then add the other details.

Location of plants. In the U.S.A., U.S.S.R., Australia, Japan and most western European countries producing steel the various raw materials are at widely scattered localities. Only in England and Alabama (U.S.A.) are the iron ore deposits close to the coking coal seams. This means that transport—especially water transport if available, as these are bulky, low-priced commodities—is a vital factor in establishing steel plants. One or more of these raw materials must usually be brought great distances to the smelting plant. In the late eighteenth century the smelters were located on the coalfields, as it took from two to $3\frac{1}{2}$ tons of coal to smelt one ton of iron ore; but today the amounts of coal and iron used are approximately equal, due mainly to more efficient blast furnace technique. The location of the newer steelworks is therefore often determined by factors other than adjacent supplies of coal and/or raw materials. This will be clearly seen in the U.S.A. maps with Chicago-Gary and Lakeside smelting centres, where large steel-producing centres are neither on coal or iron ore fields, but are readily accessible to both as well as to nearby markets and abundant water supplies.

Making steel. Enormous quantities of coal and iron ore are used in the making of steel, and it is necessary to realise that the mining and movement of these are in themselves major industries employing many thousands of workers and creating large cities, ports and railway centres (see Figures 17 and 18).

The first step in the manufacturing of steel is the treatment of the coal in huge by-product coke ovens from which are obtained the coke for blast furnace fuel and a certain amount of coal gas, which is used as a heating agent throughout the entire plant. In addition, valuable by-products are made from the coal-tar for sale in outside markets.

Coke, iron ore and limestone (for a flux) are then charged into a blast furnace, which in turn produces pig-iron and slag (crushed and sold as a by-product for road-making and concrete breeze).

Pig-iron is normally too impure to be used in industry, so it is taken to the steel-making plant, where it is charged into the steel furnaces along with quantities of scrap metal and necessary alloy metals (for steel is an alloy of iron and one or more metals). The most common furnace in use today is the open hearth because it enables accurate control over the process.

From the steel furnaces molten steel is poured into ingot moulds where it cools to sufficient hardness to allow it to be handled and rolled.

When required for the finishing processes the ingots are reheated in soaking pits and then rolled or forged to the required shape for sale to the fabricating plants. Over 85 per cent of steel produced today is rolled and the chart shows some of the principal products from this process.

The steel now passes from the steelworks to the various fabricating plants, which make it into consumer goods for the market. These plants may therefore be regarded as satellite or associated industries of the main steel-producing centres. In Figure 19 are shown some of these as they occur in the U.S.A. and in Figure 60 you may see those associated with the B.H.P. Company in Newcastle.

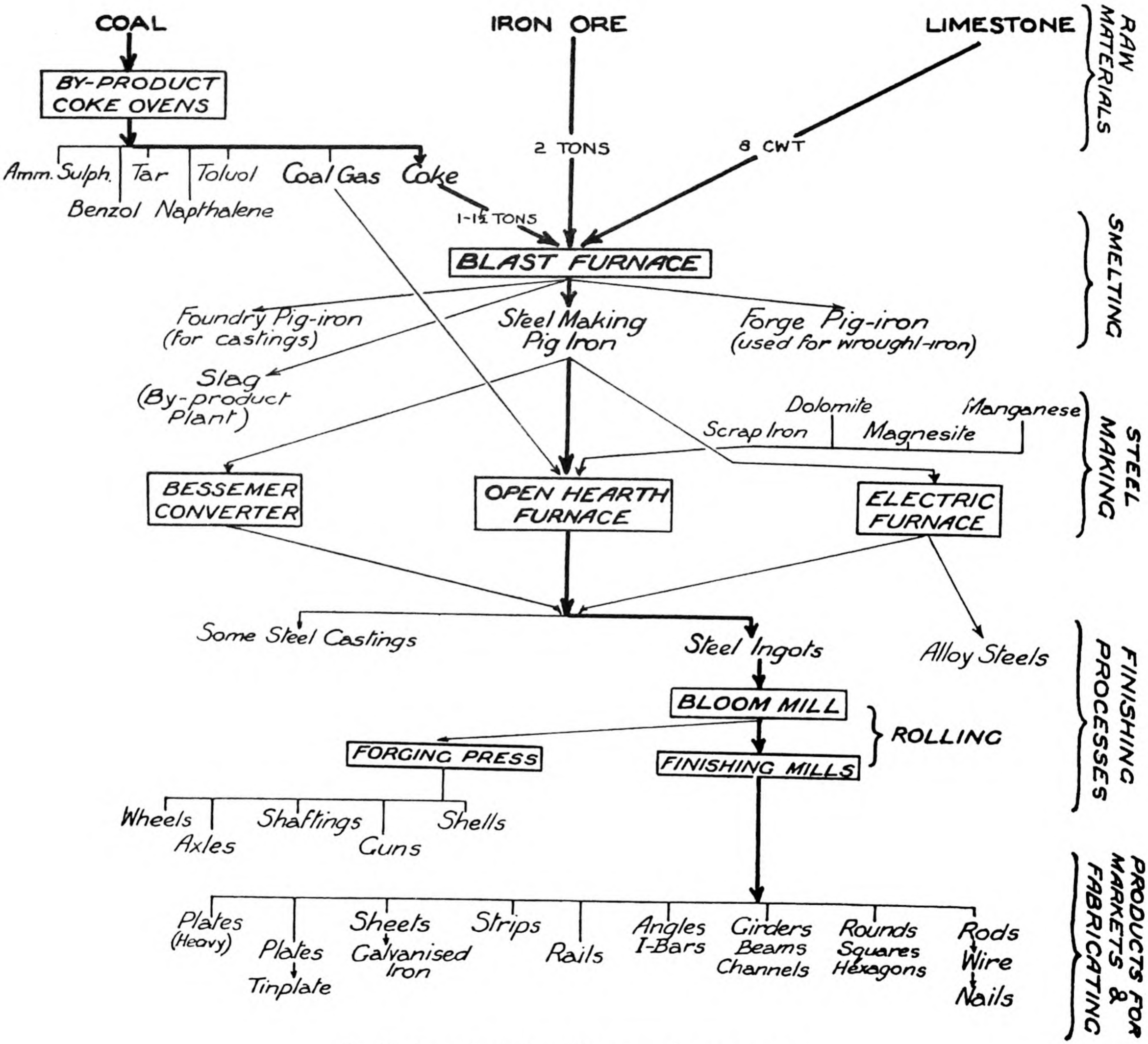


FIG. 12: Generalised chart of processes in steel making.

Figure 13 serves to introduce that part of the United States where a number of geographic circumstances provide one of the most highly industrialised regions of the world. This region is about 1,000 miles wide with a north-south distance of 400 miles, a tremendous area which should be contrasted with other manufacturing zones, e.g. South Wales.

Features to be noted include the following:

1. The respective location and areas of both inland and coastal sections of the region as a whole.

2. The pattern of the water bodies, especially the manner in which the Great Lakes link up with the Mohawk Gap (Figure 43) and the coast. The upper tributaries of the Ohio River rise near the sources of the streams of the eastern coastal plain, while the main body of the stream itself moves to the west and south to provide important navigation for barges.

3. The need for an extensive, varied and intricate transport pattern.

4. The various States and important cities. The precise location of all these should be studied as the background for subsequent studies of the industries in the region.

5. Although it is not possible to add the eastern uplands on this map, they are very significant. A good exercise would be to draw them on a separate sheet of tracing paper which can then be placed over the original here.

Finally, it is worth while finding out the relationship between this region and the agricultural regions further west (in terms of food supplies, clothes, machinery, etc.) as revealed in maps in the companion volume to this book, *The Rural Scene*.

FIG. 13: North-east U.S.A.: locality map.

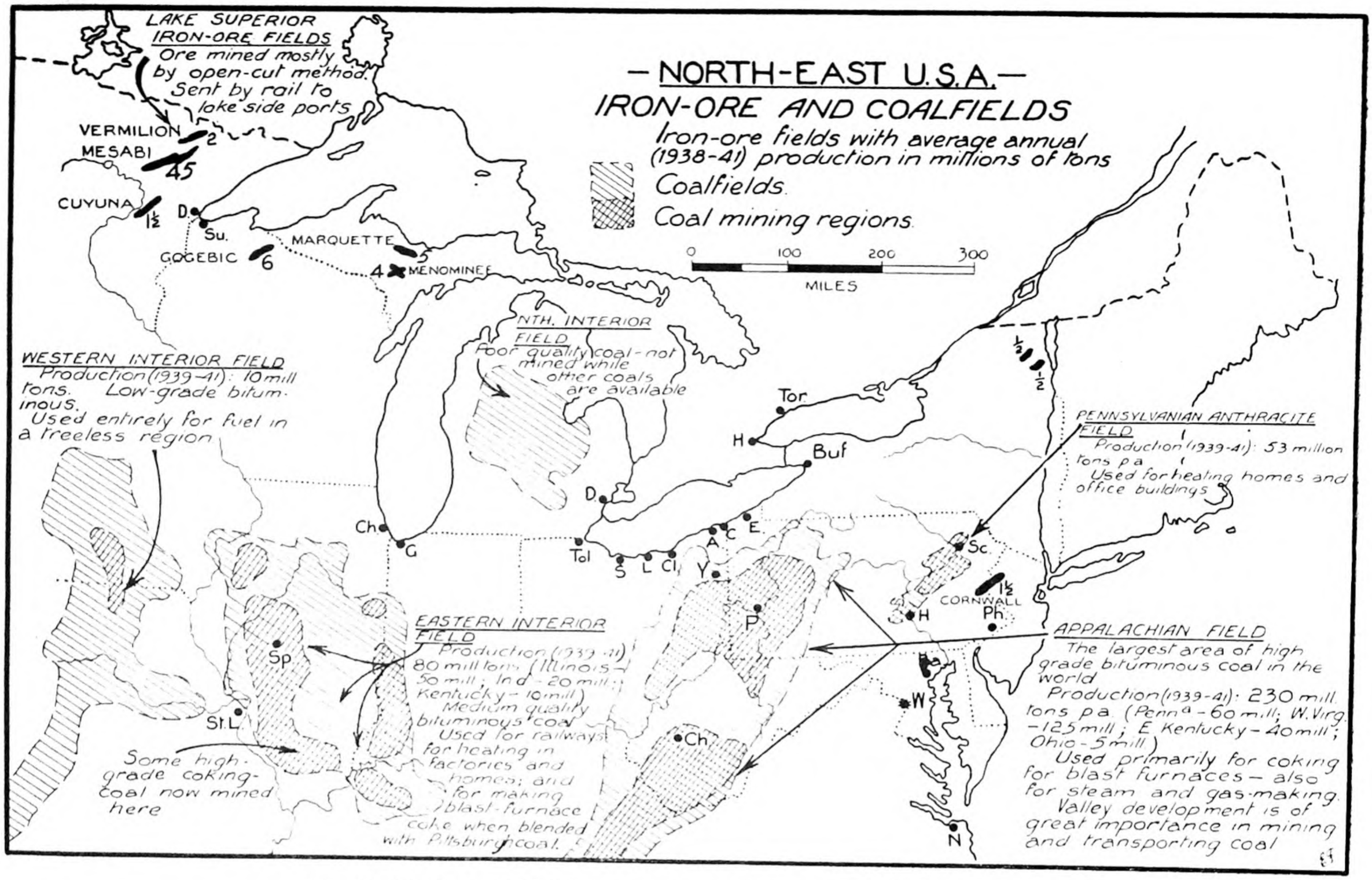


FIG. 14: North-east U.S.A.: map-summary of iron-ore fields and coalfields.

Iron ore and coalfields of north-east United States. The important information relative to these fields, shown in Figure 14, is covered in the short notes inserted on the map, which should be studied carefully. At the same time several general points are worth stressing:

1. The significance of the location of the iron-ore fields adjacent to the Great Lakes, and the Appalachian coalfields (which include those of Pennsylvania and West Virginia). Figure 14 shows the close link between these areas of mining production.

2. Coal from the Appalachian fields is extremely important as a source of coking coal for the many blast furnaces associated with the steel industry in adjacent areas.

3. About four-fifths of the iron ore of U.S.A. comes from regions marginal to Lake Superior. The figures quoted are for the 1938-41 period. Production was stepped up by the demands of World War II, but there was no decline up to 1949, when 86 million tons were produced.

This map can be studied profitably if looked at in conjunction with the rest of the series relative to north-eastern U.S.A., especially the sketch showing the major manufacturing regions (Figure 19).

Generalised cross-sections of coal seams at Pittsburgh and West Virginia. Figures 15a and 15b and their accompanying annotations illustrate several geographical facts associated with the mining and transport of coal in the Pittsburgh and West Virginia seams.

1. Both occur in plateau areas where, although gentle folds occasionally appear, the thick beds of sedimentary rocks are, for the most part, laid almost horizontally. The coal seams are interbedded with layers of sandstones, limestones and shales, and vary in thickness from a few inches to more than ten feet.

2. The dissection of the plateau areas by streams has produced narrow, steep-sided valleys of which some are from 1.000 feet to 1,500 feet below the plateau surface. In this way the coal seams have been exposed in the valley sides in the manner shown. This has greatly facilitated the mining of the coal in these areas, especially where the seams are from five feet to seven feet thick, because horizontal shafts or adits can be made and machinery used both for actual cutting and for transport.

3. In addition to these advantages, the valley floors are sufficiently wide to allow the construction of railway lines for haulage. In some instances the rivers, e.g. the Monongahela, are navigable and permit considerable barge traffic.

4. In both cases the rail haulage is down the valley for the loaded trains moving westwards, and up the valley for empty trains returning.

Coal moving eastwards has to be hauled over the narrow divides which separate the west-flowing and east-flowing rivers, and then follows the eastern valleys to the tide water. The most important of these routes are shown clearly on another map in this series (Figure 16).

Interesting comparisons can be made with the types of mining and transport of the South Wales coalfields.

5. In recent years an increasing amount of coal has been taken from open-cut or strip mines, where the coal beds lie near the surface of the plateau. The overburden is removed to a depth of up to 50 feet by steam or electric shovel and the coal thus exposed is loaded by shovel into railroad cars.

Landform and rail pattern in north-east U.S.A. Figure 16 indicates the importance of valleys and rivers for the eastward movement of coal from the Appalachian coalfields to the Atlantic seaboard. The series of parallel north-east and south-west ridges and valleys lying between the Allegheny Front and the Blue Ridge Mountains form a pronounced barrier to movement, in which the natural lines afforded by transverse river valleys have been utilised as transport routes.

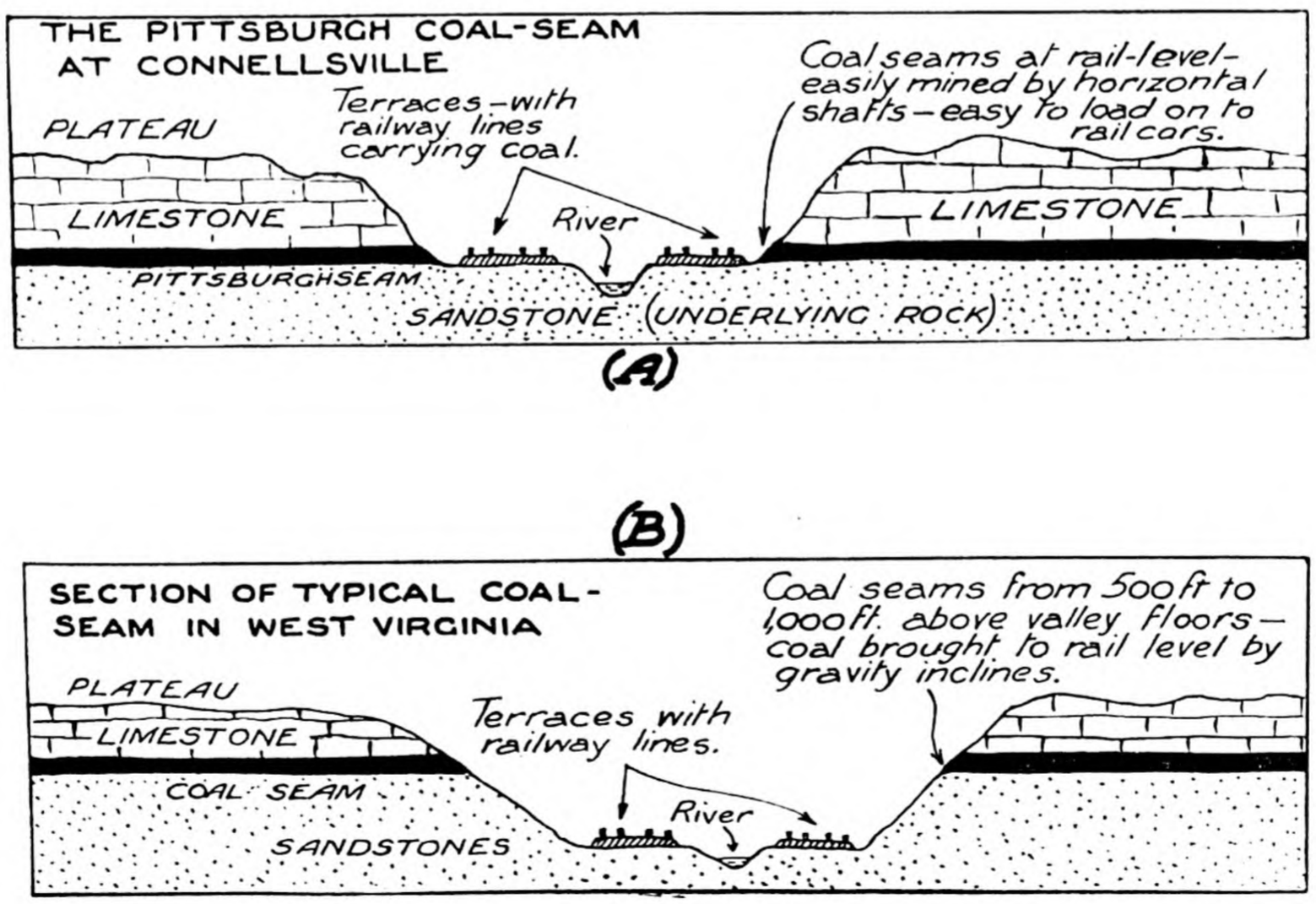


Fig. 15: North-east U.S.A.: (a) Section of the Pittsburgh coal seam at Connellsville; (b) Section of typical coal seam in West Virginia.

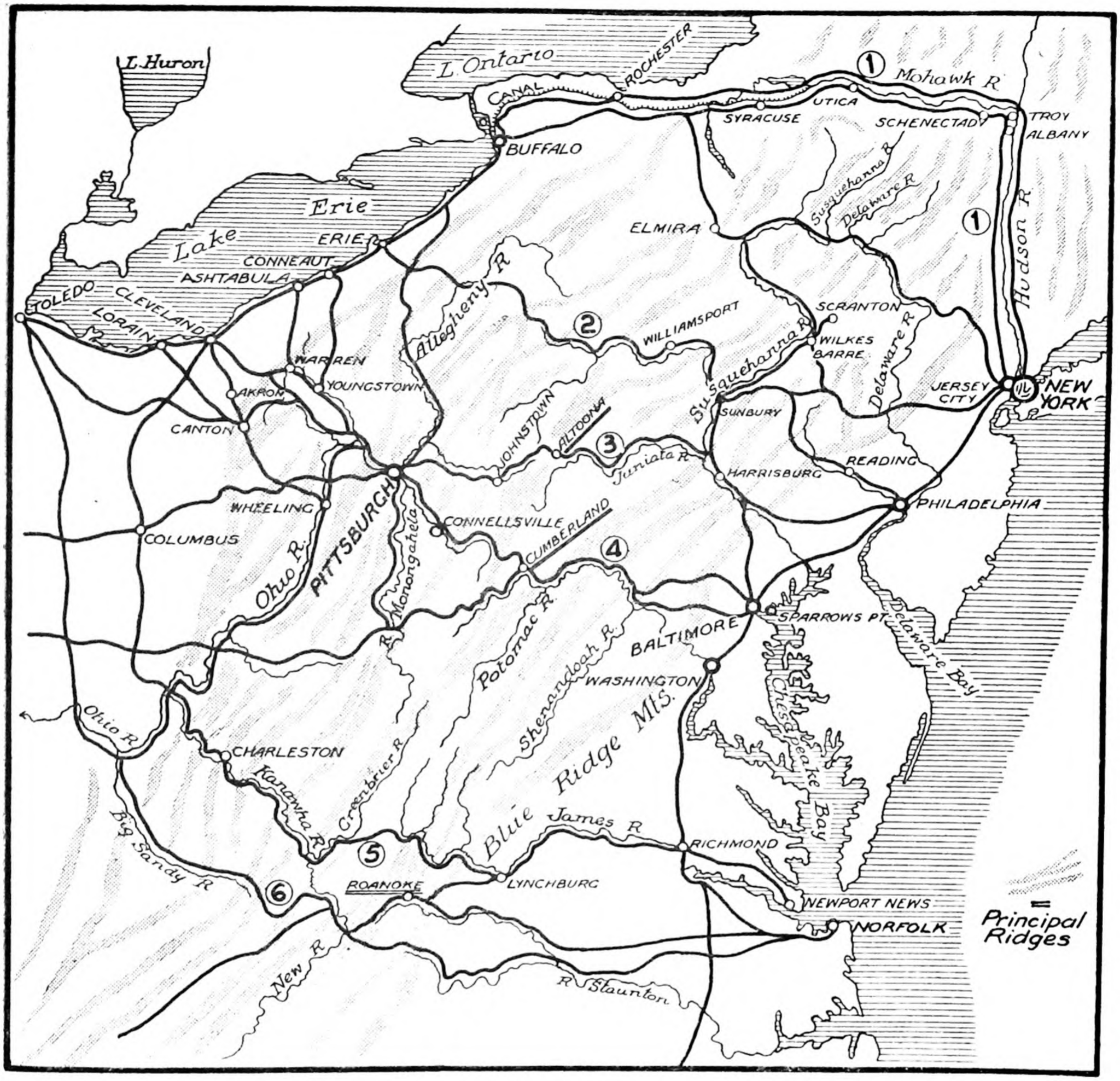


FIG. 16: North-east U.S.A.: landforms, valleys and rail patterns.

The most important of these are shown by numbers on the map:

1. The Hudson-Mohawk route, the most important from the Atlantic seaboard to the interior.

2. The Susquehanna-Erie route, which links Philadelphia with Lake Erie and which is a route for outward moving iron as well as coal.

3. The Susquehanna-Juanita-Stony Creek route, linking Philadelphia and Pittsburgh.

4. The Potomac-Youghiogheny route, linking Pittsburgh and Baltimore.

5. The Kanawha-Greenbrier-James River route linking the West Virginian fields with Newport News.

6. The Big Sandy River-Staunton River route, linking the West Virginian fields with New Norfolk.

Note also the use made of the Delaware valley as a link between New York and the Mohawk Valley.

The method of moving the coal is to take it in small trains to large assembly yards on the watersheds, e.g. Altoona, Cumberland and Roanoke. At these points huge trains are made up (some one mile long) and these move down grade to the coastal ports and industrial centres, e.g. Baltimore, Sparrow's Point and Philadelphia. From special export docks like Newport News and Norfolk, there is a further movement of coal to the north-eastern States, especially New England.

The rail pattern as described here should be compared with that of South Wales in its relation to valley formations (see Figure 26).

In the study of Figure 17 particular attention is drawn to the use of the circle and arrow diagrams since these are intended to indicate in millions of tons

(*a*) the amount of coal mined in each field;

(b) the tonnage of coal moved out for industrial use elsewhere;

(c) the local consumption of coal.

An examination of these will reveal the following facts:

1. Nearly half the coal mined in the Pittsburgh area is used locally as basic to a wide variety of industries.

2. There is a huge demand for east Pennsylvanian anthracite for domestic heating in the big cities; hence the significance of the movement of some 20 million tons to New York, 14 million tons to Philadelphia, and nine million tons to New England.

3. Although this is the largest anthracite coalfield in the world and the principal source for the United States, its importance is declining because of competition in the heating industry from other forms of fuel such as natural gas, petroleum and coke.

4. The greatest movement outwards occurs in the case of the West Virginian and Kentucky fields, since there is little local industry obtaining there; this is in marked contrast to the Pennsylvanian and Ohio fields.

5. The major movement of this coal is to the west to meet the needs of the newer industrial plants there as well as the widespread transport systems that demand steam coal. This trend in modern industry to move coal to steel mills reverses the older practice, although the long-established concerns, e.g. Pittsburgh, tend to remain fixed because of the nature of their evolution, their many subsidiary industries and the population involved.

6. There is a considerable movement to the lake-side industries, newer plants, and ports.

7. The transport of coal through the Great Lakes represents an important back-loading for the iron ores moving down from the Lake Superior fields. This coal is lifted in the ore steamers and is used mainly to provide fuel for the western wheat areas on the treeless prairies, with some passing to smelting plants at Duluth and Sault Ste Marie.

8. The eastward movement from the northern and southern Appalachian fields to the coastal ports is not for purposes of export but to meet the coastal trade, which goes chiefly to the north-eastern littoral.

9. One arrow also shows a movement southward by barge along the Ohio to the southern States which are almost lacking in coal.

From the foregoing it is possible to understand that the Allegheny Plateau is the source of most of America's bituminous coal production. Pennsylvania and West Virginia alone contribute about one-half of the bituminous coal output. The reasons for this great output are the large reserves, the ease of mining (see Figure 15), the high quality of coal, and the efficient transport facilities both by rail and river (see Figure 16). The Pittsburgh seam alone is the world's largest deposit of high-volatile gas and coking coal, a fact which has an important bearing on the iron and steel industry there and in other parts of the U.S.A. (see Figure 18).

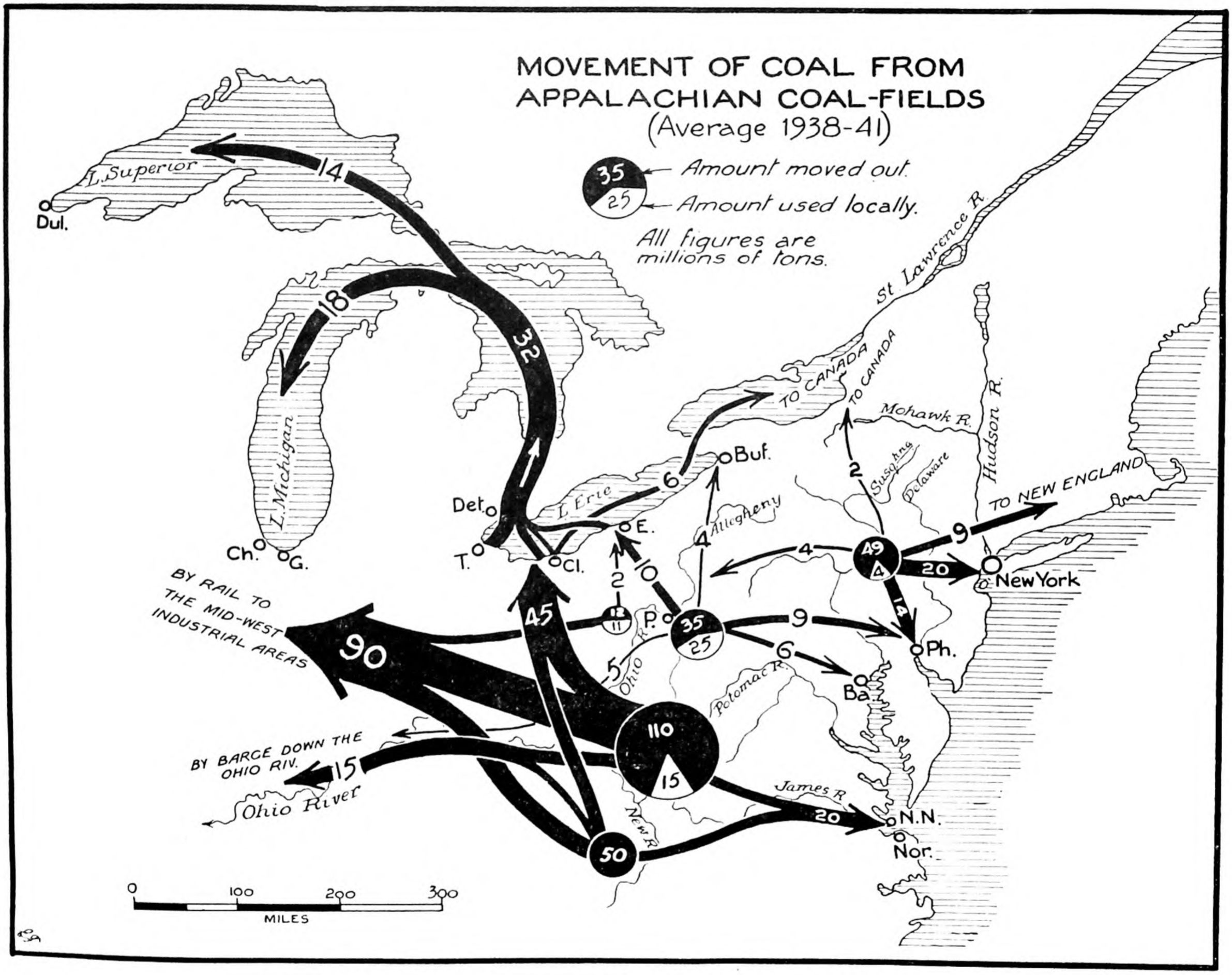


FIG. 17: North-east U.S.A.: movement of coal from Appalachian coalfields.

1. Attention is drawn to the special nature of the key to Figure 18. Thus

(*a*) dotted areas show the location of the iron ore mining fields;

(*b*) heavy lines show the proportional amounts of ore moving to each centre;

(c) shaded sections contain heavy dots indicating the smelting centres and number of blast furnaces in each.

2. Some comment has already been made on the nature and location of the ore fields, so that here special study might be made of its actual transport, which is carried out in the following stages:

(*a*) The ore from the Minnesota mines is loaded into cars, which are in turn made up into large trains and moved to weighing and classification yards before continuing to the lake ports of Duluth, Superior and Two Harbours. This rail journey is only 60 to 80 miles and trains coast most of the way.

(*b*) At ports the trains run to the dock side ore-bins and the ore is loaded on the waiting ships quickly by means of a series of chutes through which the ore pours into the holds of specially constructed vessels. Mechanical equipment is again used at the Lake Michigan and Lake Erie ports to facilitate rapid unloading.

3. A long haulage is involved, some 1,000 miles by water alone, and the Great Lakes can be utilised for only seven or eight months of the year because the connecting links such as the "Soo" canals are locked by ice in winter. It is therefore a race against time to accumulate enough ore at the lower lake ports to keep the mills operating throughout the year. Hence the extensive use of mechanical equipment to handle the heavy material.

In spite of the closing of the canal for the winter months, the volume of traffic moving through the "Soo" canals in a normal year exceeds that of Panama, Suez, Welland and New York State barge canals combined. A further interesting fact concerning the movement of ore is its import to the east coast, to Sparrow's Point from overseas, since it is cheaper that way than for haulage from the western fields.

4. In connection with the significance of water transport in the carriage of raw materials, mention must be made of the movement of the metallurgical limestone which is so important in blast furnaces for the removal of impurities from the iron ore. The major source of this is in Alpena County, Michigan; as indicated on the map, some five million tons are brought down the lakes each year at much cheaper rates than if it were carried overland.

5. With respect to the smelting areas, the number of blast furnaces should be noted in each, but these numbers are not strictly indicative of the relative importance of the various centres shown because of the age and size of the furnaces themselves.

Of the main centres shown certain special features may be said to be characteristic of each. Thus:

(*a*) *Pittsburgh.* Situated on the Pennsylvanian coalfield, it is the largest of the steel manufacturing centres, producing about 24 per cent of all the steel made in the United States. Its early growth was due in part to the presence of high quality coking coal and to the ease with which iron could be brought by barge—and later by rail as well—from the lake ports.

(*b*) *The lakeside region*: *Erie.* Of the various ports handling the ore here, some merely unload and pass it on to Pittsburgh. At others, e.g. Cleveland and Buffalo, smelting plants have been established where ore, moving down the lake, meets coal brought from the Pennsylvanian field on an easy down-grade.

(*c*) *Michigan*: *South Chicago and Gary.* Here large steelworks have been established chiefly because of the large western markets available for large-scale industry. Although, as shown in Figure 14, the Illinois coalfield is near this particular district, coal is not as good for coking purposes as that from Pennsylvania and West Virginia. As has already been seen, coal from these fields comes via Lake Erie and the water route, but some, especially in winter, is railed direct.

(*d*) *The Atlantic seaboard region.* The chief advantages of this region lie in its close proximity to tide water and to large centres of population. It has been indicated already that the coking coal is moved down from the Pennsylvanian fields, but the iron ore, originally of local origin, is now largely supplemented by imported ores from the countries indicated on the map. The chief steel-producing centres in the region are near Philadelphia on the Delaware River, and south to Sparrow's Point near Baltimore, at the head of Chesapeake Bay.

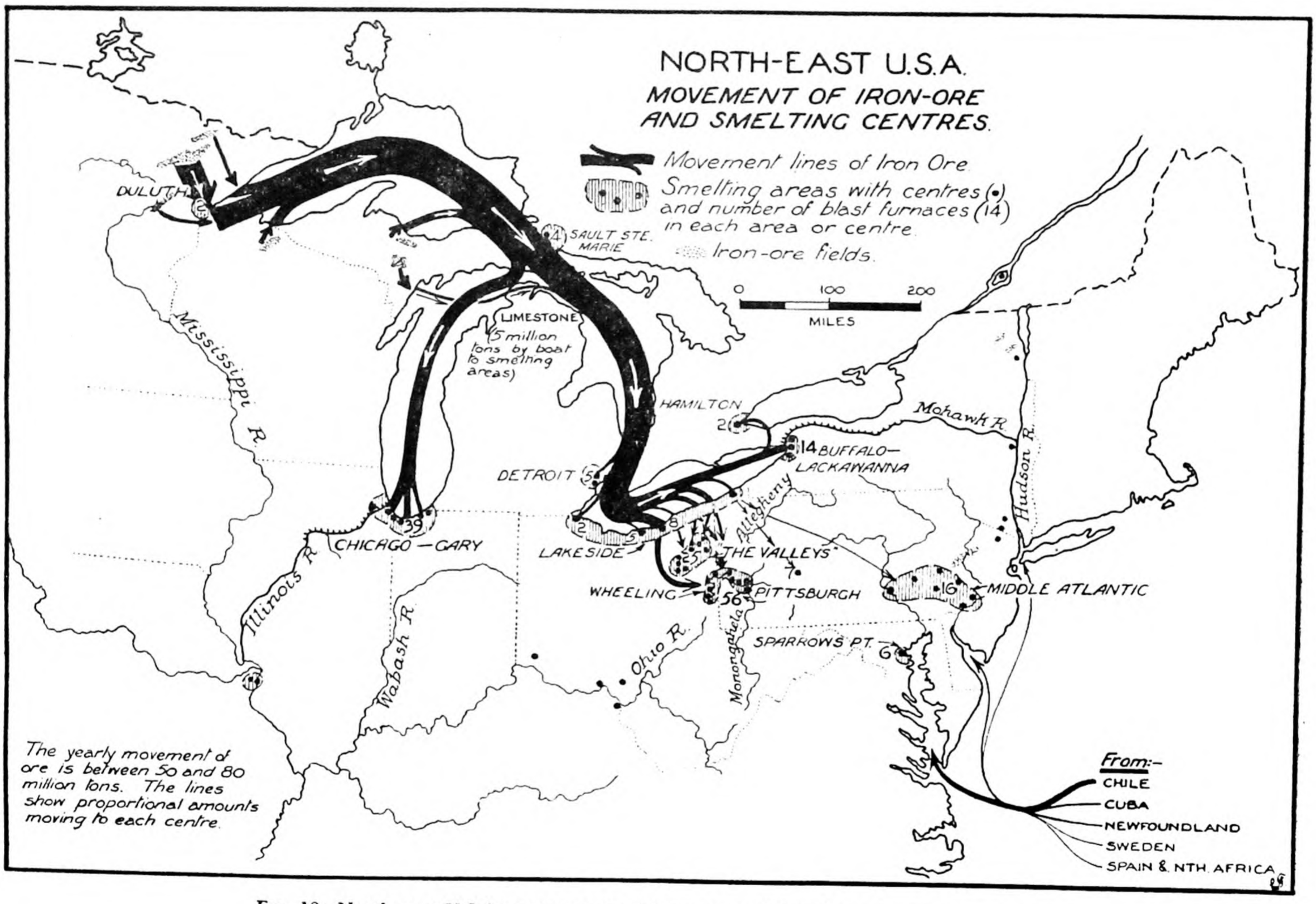


FIG. 18: North-east U.S.A.: movement of iron-ore and location of smelting centres.

The American manufacturing belt (principal sub-regions). Figure 19 summarises the material relating to the present location and character of manufacturing in the north-eastern section of the United States. For convenience of analysis and discussion it has been divided here into a number of sub-regions.

In particular, it indicates the large number of industries developed in association with the one basic to them all, iron smelting. This can be seen in such cases as the special interest in motor car manufacture in the Michigan region and that of agricultural implements in the Gary-Chicago-Milwaukee region.

A number of factors have combined in different ways to localise secondary industry in this area, including the historical background, physical features of site, access to raw materials, sources of power, means of transport, labour supply and markets. In nearly all instances certain of these determinants have been stronger or more in evidence than others in giving a special geographic character to each sub-region. Moreover, there can be such an emphasis within each sub-region itself.

To illustrate this we make a selection of examples from the sub-regions mapped. The student may attempt a wider treatment as a worthwhile individual project.

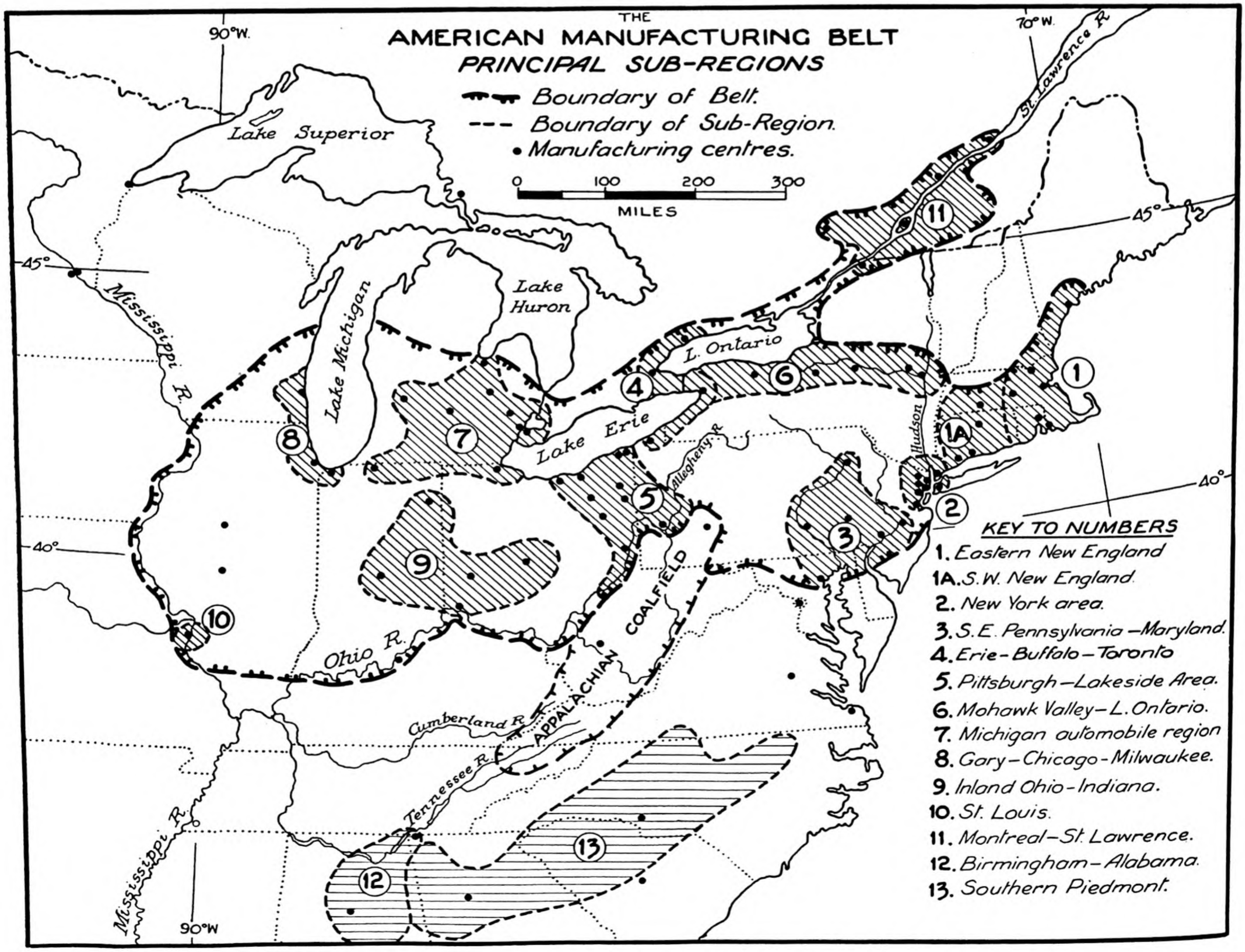


FIG. 19: Sub-regions of the American manufacturing belt. (*After White and Foscue*)

1. Historical factors. These are much in evidence in the cotton textile industries of eastern New England. Here the quality of the water and its use for power, the suitably damp air, the skill of the pioneer spinners and weavers, and the early supremacy of Boston as a port, gave this region a lead in the cotton trade which lasted for many years. Old-fashioned plants and methods caused it to decline and migrate mainly to the southern cotton States. But it still maintains a national importance with its specialisation in the production of fine quality and style goods.

2. Physical features of site. A very good example of this is in south-east Pennsylvania at Chesapeake Bay, and the Delaware River flowing across a coastal plain. These made possible the development of excellent ports and water frontages and permitted industrial and urban expansion on the flat land. Hence the early lead obtained by cities like Philadelphia in a wide range of activities such as shipbuilding, sugar- and oil-refining, leather-tanning and tool-making. Baltimore, a tide-water port, has one of the largest iron and steel plants in the world at Sparrow's Point, while Wilmington is the centre of the enormous Du Pont chemical works.

3. Access to raw materials. The Chicago-Milwaukee sub-region, located as it is in what is virtually the centre of the continent and on the large water expanses of Lake Michigan, has had ready access to a wide range of raw materials for manufacturing purposes. For example, Chicago itself is one of the nation's foodstuff producers with its ability to draw upon the meat, corn and wheat of neighbouring areas. In addition it is the greatest agricultural machinery manufacturing centre in the United States, supplying the mechanised farming areas of the corn belt and the wheat belts. The strategic locations of iron ore, limestone, coal and water supplies have led to the phenomenal rise of Gary as one of the world's iron and steel centres, while an abundance of suitable timber has created a large furniture-making trade in the region. Milwaukee, capitalising on the adjacent supplies of steel from Gary, has many heavy machinery industries, specialising in the production of agricultural implements.

4. Sources of power. The abundance of cheap electrical power from Niagara Falls has been a factor in the development of the outstanding industries in the Erie-Buffalo-Toronto sub-region. It is utilised in the making of aluminium in the City of Niagara Falls try of Hamilton; in the machinery and meat packing itself and at Massena (see Figure 13); the steel industry of Toronto; in the metal products of Erie; and in the flour mills of Buffalo. Another example of the predominance of sources of power can be seen in the Pittsburgh-Cleveland sub-region already discussed with respect to its dependence upon the Appalachian coalfield (see Figure 14).

5. Means of transport. The Montreal-St Lawrence sub-region is situated at the junction of the lake and river traffic of the continent and so has developed industries closely associated with water transport. Of these, pulp and paper manufactures are particularly significant because of the need for vessels to handle the bulky raw and finished products. Logs also come down in great numbers in the southward-flowing streams. Ottawa and Three Rivers are the major cities connected with those activities. On the other hand water transport is also vitally important in the handling of large quantities of wheat from the interior prairies, and so creates a special place for Montreal as a port for wheat storage and a flour-milling centre. For the importance of the Great Lakes as a means of transport see Figures 17 and 18.

6. Labour supply and markets. New York illustrates the part played by these two factors in the localisation and special character of a region. These are dealt with at length in the treatment of New York as a study of urban geography, but mention is made here of the place of the garment industry there. With its enormous population there is a constant demand for ready-made clothing; at the same time those numbers are able to supply the necessary labour force to produce it in sufficient quantity.

Within the huge area of this manufacturing belt, which is about 1,000 miles wide and 400 miles deep, there are certain regions which exhibit special characteristics other than those just described. These will be found quite easily if the various sub-regions are examined in greater detail. A good example is that of Buffalo, where are some of the largest flour mills in the world, although wheat is produced many miles away. This is because Buffalo is at a strategic meeting-point of land and water transport, and at this site off-loading advantage has been taken, together with other favourable factors of power, etc., to set up processing plants. Using the appropriate books listed in the bibliography the student might find parallel examples in the various sub-regions mapped in Figure 19.

U.S.A. Manufacturing regions. The purpose of Figure 20 is to relate the manufacturing belt as outlined in Figure 19 with the rest of secondary industry in the United States. Special features mapped here are:

1. The general spread of some form of manufacturing over most of the eastern States except where rugged uplands prevent their establishment as in the case of the Blue Ridge and Allegheny areas or the Ozarks.

2. The great concentration of industries in the north-eastern regions. The broken line on the map indicates the boundary of the manufacturing belt described in the previous section (Figure 19).

3. The considerable density on the west coast at such centres as Los Angeles, San Francisco and the Puget Sound region. These are newer areas using electric power from the huge reservoirs in the nearby mountains.

4. The only significant area with a concentration resembling the above is that of the Piedmont with its interests in the making of such commodities as cotton goods, tobacco, pulp (paper), rayon, clothes, furniture and aluminium.

5. Where there is evidence of secondary industry spreading over the Rockies and the agricultural regions of the middle-west, it can be related to such activities as the processing of meat, minerals and wheat. Interesting geographical study is afforded the student if he will try to discover the major types of industry as plotted here and their relationship to various determining factors. Reference books ought to be used, e.g. White and Foscue, *A Regional Geography on Anglo-America,* (see Bibliography, page 137).

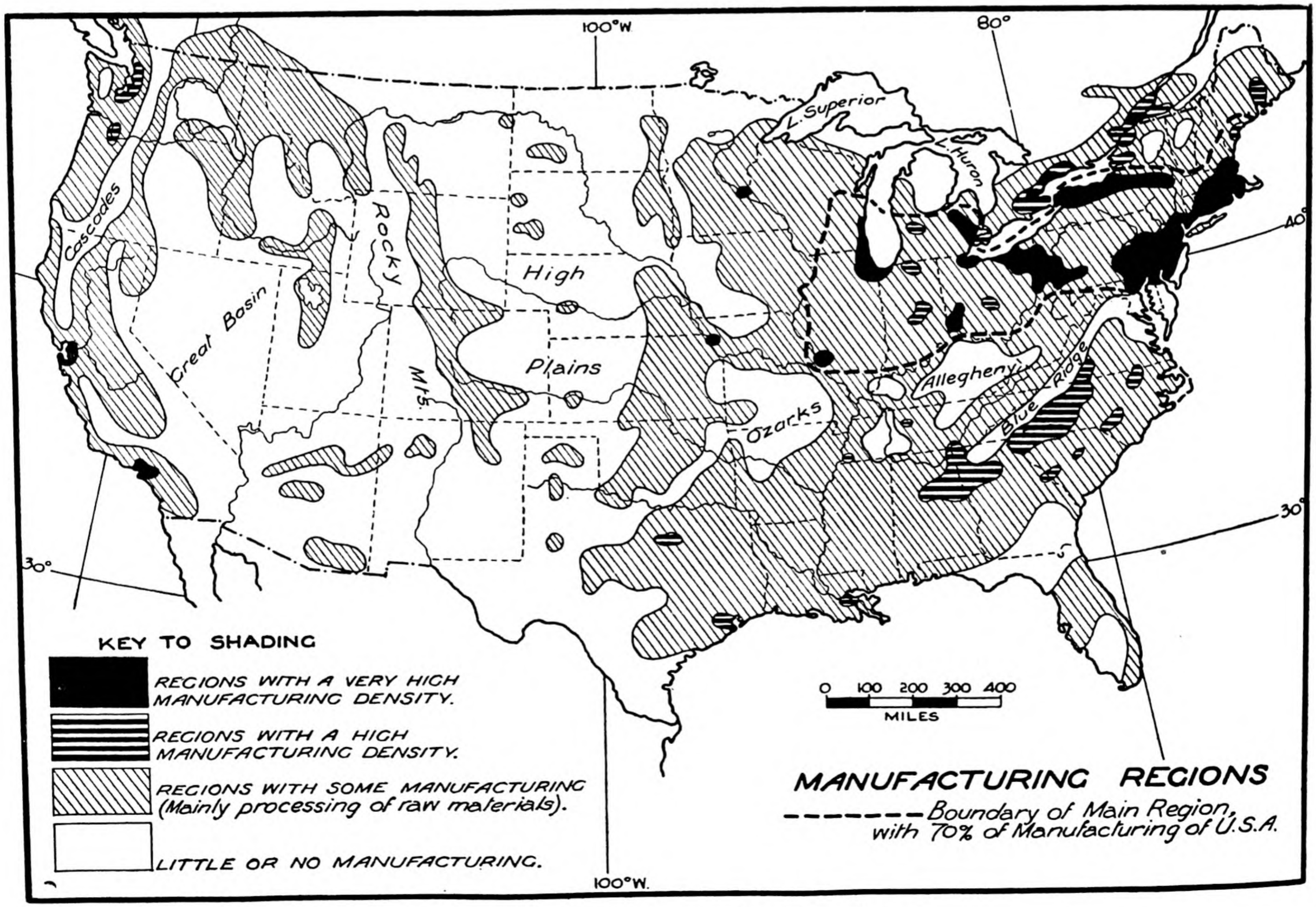


FIG. 20: U.S.A. showing manufacturing regions.

As steel is an alloy of iron and one or more of several metals the supply of these metals is of great importance to the industry. Study Figure 20(a) and note: (*a*) the names of the principal steel alloy metals; (*b*) the location of the producing centres in relation to the steel manufacturing countries. In this latter instance only the U.S.S.R. and the U.S.A. produce both iron and alloy metals in quantity. No country has a full supply of all essential alloy metals and there is considerable movement of these ores from the scattered places of their production to the steel-making centres of the world.

The annual production of most of the alloy metals is quite small, but their significance to the industry is out of all proportion to the amount produced. Without them it would be impossible to produce steel.

Cobalt is used mainly in stellite alloys for high-speed cutting tools. A typical stellite alloy contains 60 per cent cobalt, 25 per cent chromium and 15 per cent tungsten or molybdenum. It is also used for making cobalt steel, which is similar to nickel and tungsten steel. World production is about 3,000 tons a year and comes mainly from Belgian Congo, Northern Rhodesia and Morocco.

Chromium is used in various ways in steel making.

(*a*) Small amounts (less than 3·5 per cent) increase the hardness, tenacity and resistance to erosion. These steels are used in motor vehicles, tanks, railway carriages and bridges.

(*b*) Steel with more than 12 per cent chromium is stainless and rustless and is used in the chemical industries and for household cutlery.

(*c*) Chrome-nickel steels are used for dairy equipment, armour plate and marine engines.

(*d*) Mixed with magnesite it is used for making refractory bricks for lining steel furnaces.

World production of chromite is approximately 800,000 tons a year and comes mainly from the U.S.S.R., South Africa, Southern Rhodesia, Cuba and the Philippines.

Manganese is used principally as a de-oxidiser and de-sulphuriser in the making of steel. The one per cent that remains in the iron imparts elasticity and tenacity to the steel. Where the percentage is increased to 12 per cent a steel of very high tensile strength is produced. It is used for rail-crossings, rock crushers, clutches on cars and sprockets. World production is about $4\frac{1}{2}$ million tons a year coming mainly from the U.S.S.R. ($2\frac{1}{2}$ million), and India (800,000).

Molybdenum. The addition of 1 per cent of molybdenum to steel, either alone or in combination with other alloy metals, increases its tensile strength and ductility. Steel containing molybdenum is widely used in motor-cars, excavating machinery, machine tools, aircraft, pumping equipment, oil refineries, agricultural implements and locomotives. A major use of the metal is in the manufacture of stellite alloys (see

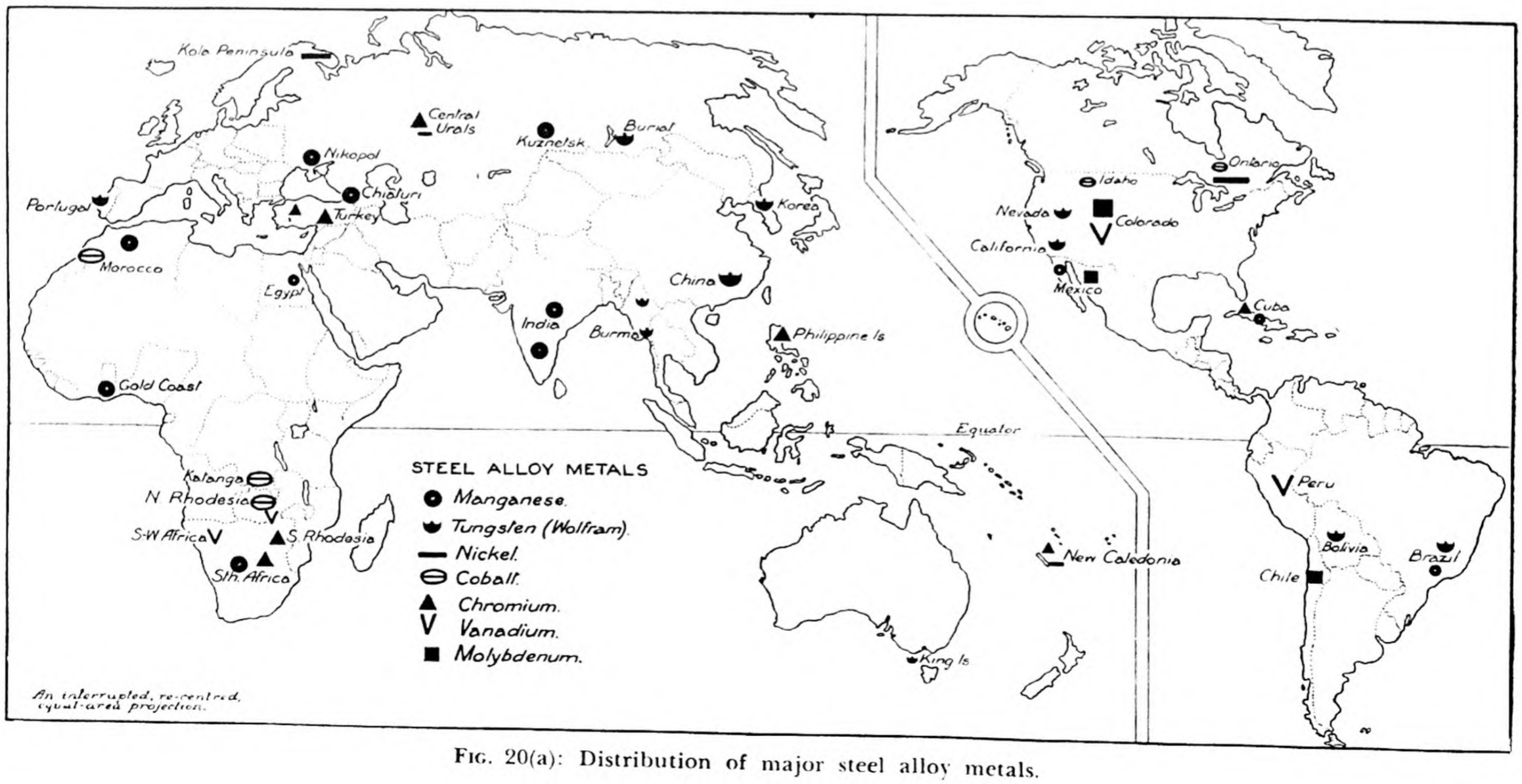


FIG. 20(a): Distribution of major steel alloy metals.

cobalt). World production is only 15,000 tons a year, over 90 per cent coming from the U.S.A.

Nickel. Very little nickel is used throughout the world each year, yet its importance to industry is very great. Low nickel steels, with less than seven per cent nickel, have a very high strength, toughness and ductility. They are used in the manufacture of motor-cars, electric generators, mining and mill machinery and railway equipment. High nickel steels (7-35 per cent nickel—usually with some chromium) include stainless steel, heat and electricity-resistant steels and chemical industry steels.

Nickel steel with 36 per cent nickel does not expand or contract with ordinary temperature changes and is called "invar". It is used for standards of length and for making gauges for industrial purposes. World production of nickel is about 100,000 tons a year, with 85 per cent coming from Canada.

Tungsten imparts great hardness and heat-resisting properties to steel. It is used (usually with some chromium and vanadium or molybdenum and cobalt) in the manufacture of high-speed tool steels which cut ordinary steel easily, even at red heat. Its great value is in enabling the work to be done at high speeds, often lessening the time taken by as much as 90 per cent. It is also used in the manufacture of stellite metals. World production of wolfram tri-oxide is about 25,000-30,000 tons a year of which 10,000 tons comes from China and over 2,000 tons from each of Bolivia, Brazil, Portugal and Korea.

Vanadium is used in the making of high-speed tool steels. Less than one per cent of vanadium in steel imparts remarkable toughness and resistance to the metal. Spring steel, forging steel for axles, gears and driving shafts all contain vanadium. It is also used in steels for armour plate, shells, gun parts and heavy duty machinery. World production is approximately 2,000 tons a year, of which the U.S.A. produces 50 per cent and Peru 25 per cent.

Other alloy metals used in small amounts for special alloy steels include:

(*a*) **Titanium** from the black sands of Coolangatta and Tweed Heads as well as Brazil, India and Norway, used for hardening. It occurs with zirconium in nature, the latter now being used to produce light-weight armour plate and projectiles.

(*b*) **Tantalum and niobium** from Pilbara (W.A.), Katanga, Nigeria and the U.S.A., used in the making of saws and springs.

(*c*) **Lithium** from the U.S.A. and South Africa, used for specially hardening steels.

(*d*) **Cadmium**, obtained as a by-product in the refining of lead-zinc ores (see Chapter 3), used for plating steel and in making rust-resisting alloys.

(*e*) **Cerium**, obtained mainly from Travencore in India, made into an iron-cerium alloy and used for the sparking element in cigarette lighters.

5

SOUTH WALES

The physical features of the South Wales area. A study of Figure 22 shows that the major physical features of the South Wales area are:

1. **The uplands.** Bounded by the 500 foot contour and rising to over 2,000 feet, parts of these offer magnificent mountain scenery; but because of past glaciation, poor soils and cold climatic conditions, much of the region is a series of monotonous moors where the main vegetation is heather and mountain grasses and shrubs. Within these there are substantial pasture

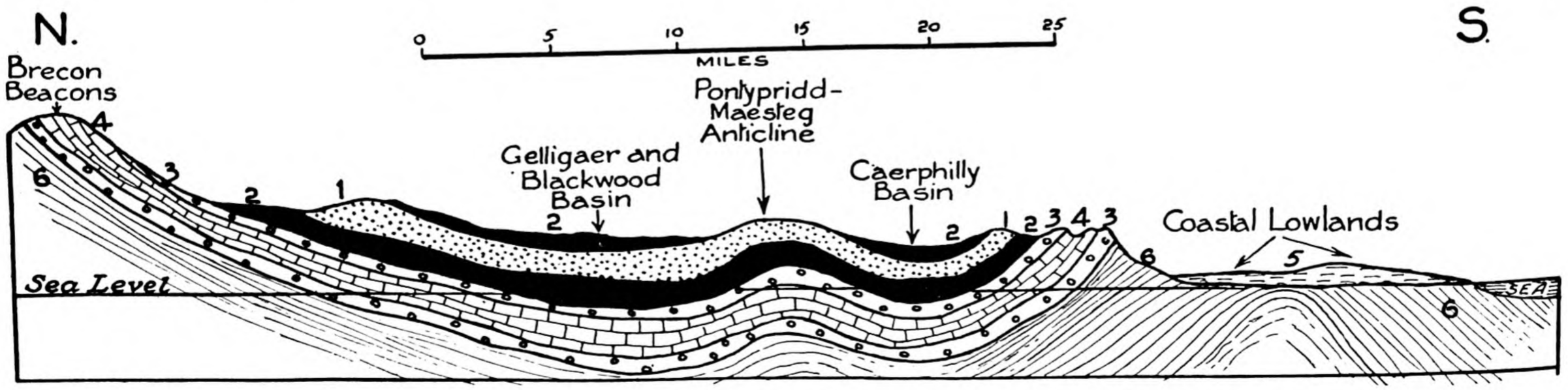


Fig. 21: South Wales: diagrammatic section of coalfield. 1. Pennant Grit. 2. Coal measures (upper and lower). 3. Millstone Grits. 4. Limestone. 5. Alluvial deposits. 6. Old Red Sandstone (Devonian). (*After Stamp and Beaver*)

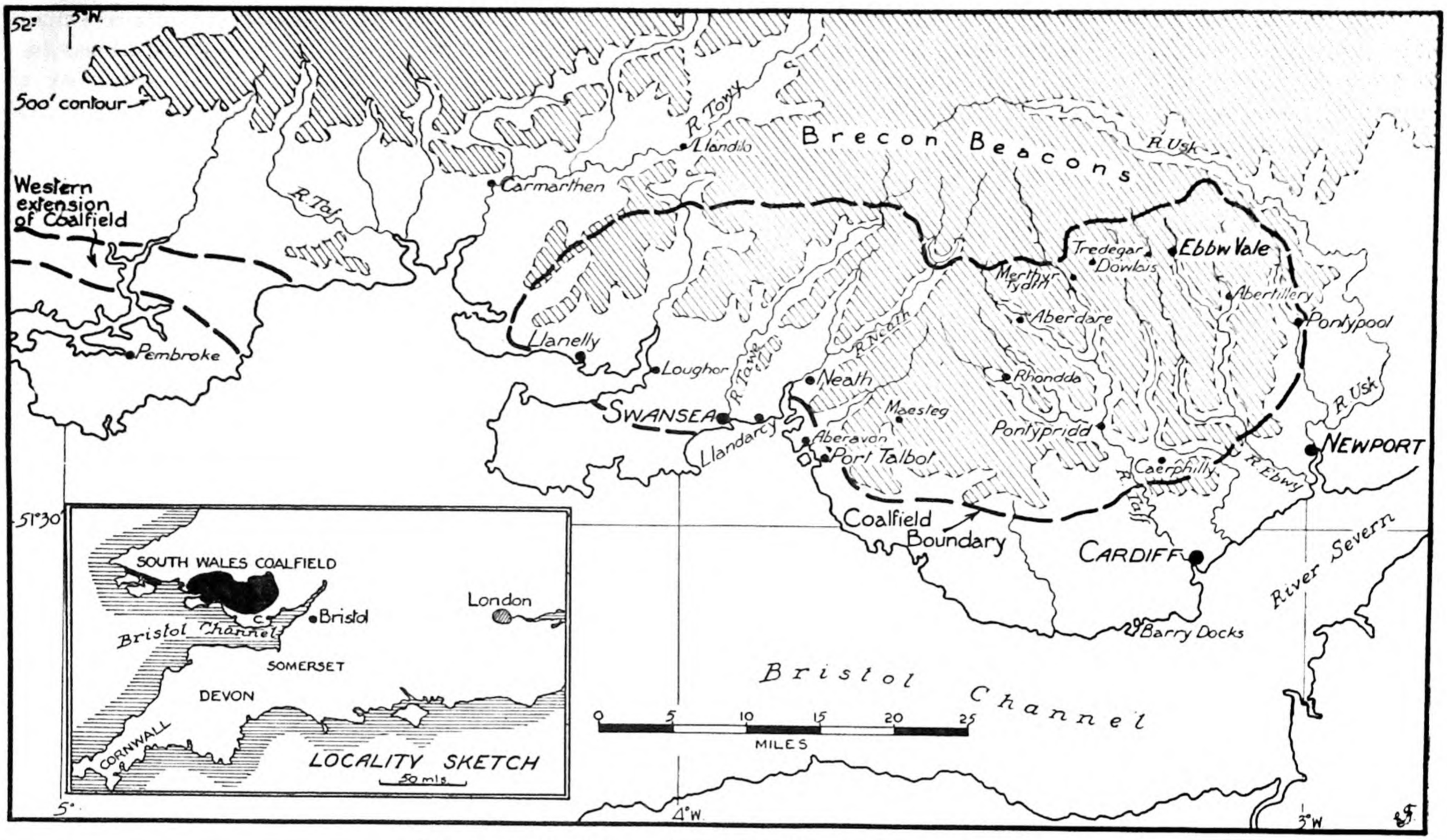


FIG. 22: South Wales: physical (highland areas are shaded).

lands which are utilised for sheep raising. As in the Tweed Valley (see Figure 28) there is an interesting seasonal migration or transhumance from the moors to the adjacent valleys.

2. The valleys. A series of these runs either south-eastwards or south-westwards. They are drained by streams which rise mainly from the locality of the Brecon Beacons. The valleys are narrow and deep-sided, especially in the upper reaches, where they exhibit many characteristic glacial features. Small areas of fertile soil occur in alluvial tongues on the valley floors and allow some cultivation, e.g. oats and potatoes; but on the whole there has been a closer link with pastoral occupations since early times. The special significance of these valleys in more recent years has been their close connection with the coal industry, since the erosion of the overlying sandstones has made possible the easy mining of rich coal seams. Note the coal boundary shown by the broken line (see Figure 23). The valleys have always been the sites of the main settlements and the natural roadways down to the coastal plain.

3. The coastal plain. This is open low-lying country stretching from Pembroke to Newport with varying widths. The soils are largely alluvial, and this fact, together with ease of transport and a mild climate, has favoured agriculture and a fairly dense rural population for centuries. In recent years arable agriculture, e.g. wheat growing, has given way to the pasturing of high quality dairy cattle. These provide important sources of butter and milk for the adjacent industrial areas which have developed mostly around the small settlements of the estuarine ports along the tidal waters of the Bristol Channel, e.g. Cardiff and Newport. In their natural state these were scarcely able to provide accommodation for the large ships needed for the coal and associated industries. Nowadays they have large efficient docking systems of various types to cope with a wide range of activities.

Diagrammatic geological section across the South Wales coalfield (Figure 21). This generalised diagram shows how the coalfield lies between the Brecon Beacons and the Bristol Channel and consists principally of a huge syncline formed by great earth-folding movements after the coal measures were laid down over an extensive area in South Wales.

Subsequent erosion has produced the following features:

(*a*) Where there are outcrops of the grits, limestones and sandstones in the uplands like the Brecon Beacons, there are the areas of high wild moorland, already described in connection with Figure 22.

(*b*) Where there are recent rocks, as on the coastal lowlands, the country is undulating plain as in the agricultural Vale of Glamorgan.

(*c*) Where the river valleys have cut down into the overlying rocks the coal seams have been exposed in both the sides and the bottoms of the valleys; this meant that mining methods in the early stages of the industry consisted mainly of tunnels or adits driven in horizontally, the coal being handled by gravity (see Figure 15b).

Most of the easily worked coal has now been exhausted and today it is mined by shafts. The seams are also thinner than those worked 200 years ago, too thin in fact to allow for the extensive use of machines, although cutting machines are used in seams of 18 inches. The general result has been that mechanisation has brought an increase of only 13 per cent production and the over-all output per man is now one ton per day.

Subdivisions of the Welsh coalfield. The Welsh coalfield is shaped like an oval trough and has an area of about 1,000 square miles. Its width varies between 10 miles and 17 miles and its greatest length is 75 miles.

As Figure 23 indicates there are changes in the types of coal mined in the western, central and eastern sections.

1. In the western region is anthracite, a type of coal somewhat different from the rest of British coal and especially valuable to ships and factories because it gives great heat with little smoke. Export was made easier because of two large harbours at Carmarthen and Swansea, which enabled vessels to get close to the fields. Generally the beds of the anthracite coal are difficult to mine because they have faulted considerably, and as will be seen later, there has been a big decline in the export of this coal for a number of reasons. At the same time there has been local growth in the associated steel and tinplate industries.

2. In the centre, smokeless steam coal occurs, the most notable producing area being around Aberdare and the Rhondda Valley. This coal is of various grades and has become world famous as bunker coal for steamships and as gas coal. The latter, the chief export coal, is moved through the ports of Cardiff and Newport.

3. The bituminous coal of the eastern region provides splendid coke for metallurgical industries, as well as fuel for railways and domestic purposes. There is a large export from the adjacent ports of Barry (Cardiff) and Newport.

On the whole it would be true to say that the types of coal available in South Wales would represent 30 per cent bituminous, 20 per cent anthracite and 50 per cent steam.

4. In the earlier stages of the industry the fine quality of the coal for bunkering purposes, its locality

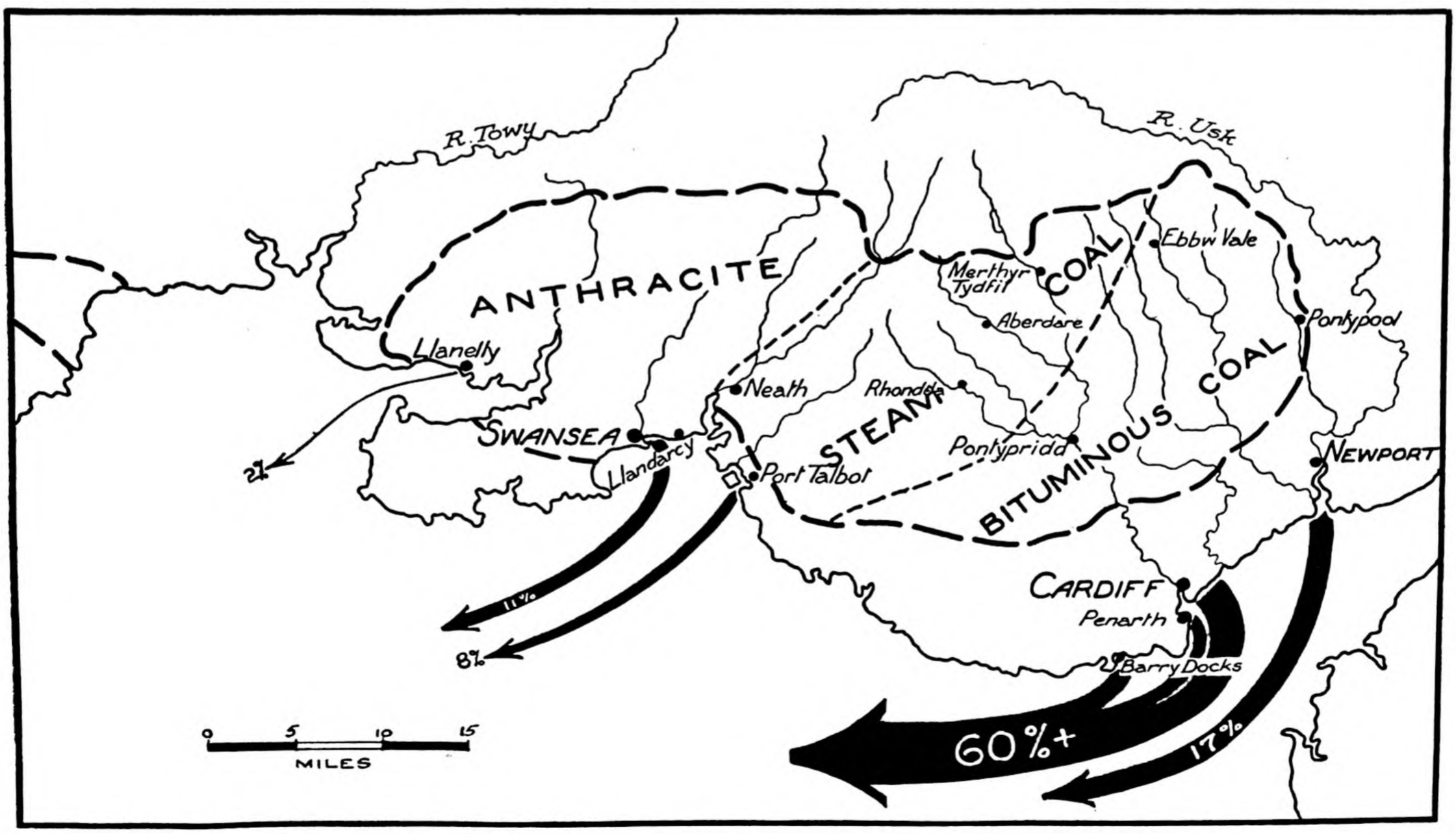


FIG. 23: Subdivisions of and exports of coal from South Wales coalfields (total 20 m. tons).

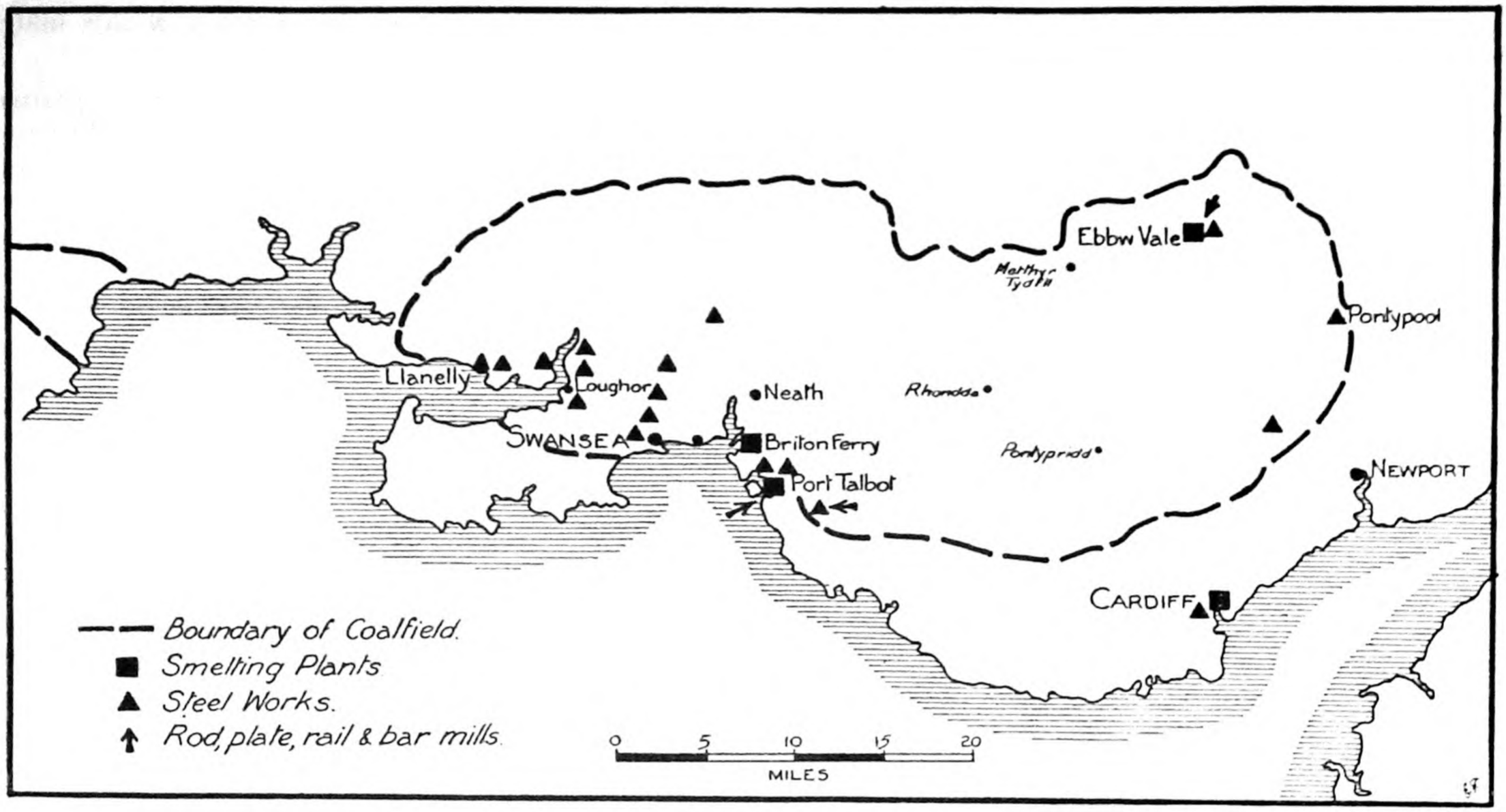


FIG. 24: South Wales: iron-smelting and steel industries.

in relation to good harbours, and the demands of South American and Mediterranean countries (deficient in coal) relatively close to Wales led to the development of a large export trade. Demands were made also by the rise of local industries associated with the original presence of iron ore, timber and water supplies, which led to iron smelting and the growth of iron and steel industries.

5. The export figure dropped from 35 million tons in 1920 to less than 20 million tons by the late 1930s. In 1938 the quantity exported amounted to slightly more than 20 million tons.

This decline was due to the operation of several factors:

(*a*) increase in the number of oil-burning steamers, especially in the Navy, which had been a principal user of Welsh coal;

(*b*) reduction in output due to the exhaustion of the easily worked seams;

(*c*) the effort of European importing countries to become independent of coal imports, a result of the policy of self-sufficiency which grew up during the 1930s.

6. Of the exporting ports shown on the map the following points are worthy of mention:

(*a*) Cardiff (and the Barry Docks), at the outlet of a number of converging valleys, became the principal exporting port; like all great exporting harbours, it also has excellent facilities for importing cheaply. Steamers can always get return cargoes and this has resulted in the growth of such industries as flour-milling, a major industry at Cardiff.

(*b*) Newport is supplementing Cardiff as an exporting centre, since it is nearer the more recently opened portion of the coalfield. It also has large shipbuilding yards and one of the largest floating docks in the world.

(*c*) Other exporting centres are Swansea, Port Talbot and Llanelly, which handle the anthracite exports from the western end of the field.

Iron smelting and steel industries in South Wales.

1. The location of the industries shown in Figure 24 has an interesting background of historical geography. In the early stages of coal-mining in the north-east of the field iron ore was discovered between the beds. Of a good quality and easy to extract by the prevailing adit method, its association with coke-smelting led to the iron industry's being established at Merthyr Tydfil, Ebbw Vale and Pontypool. This in turn resulted in the development of a better transport net of rail, road and canal to the coast, where there was a corresponding growth in export dock facilities at Cardiff and Newport.

With greater demands and newer techniques of manufacture, the ore in these fields was, except in one or two cases, gradually abandoned by the 1860s and replaced by imported haematite, especially from Spain. This being landed around the tide-water ports the furnaces and steel works tended to group there in much the same locations as shown.

2. The main survivor of this change in geographic values has been Ebbw Vale, where, in spite of the disadvantages of distance from ports and the railing of ore from Northamptonshire, huge new works still operate after having been started with government aid. This was an attempt to bring some relief to areas that were feeling the distress of unemployment due to the closing of obsolete plants during the depression of 1929-32.

3. Surveying the industry as it functions today, the following features are worthy of special note:

(*a*) the large number of steel works (plants which have no smelting section but make steel products from imported pig-iron and scrap) indicated by solid black triangles;

(*b*) the comparative absence of steel and fabricating plants other than those concerned with the making of plates and sheets for the tin plate and galvanised iron industries, the most characteristic of South Wales (see Figure 25), absorbing about 80 per cent of the steel made in the country;

(*c*) the close association of plants about Swansea in the west, where the original smelting of tin and zinc had its origin;

(*d*) the marked "vertical integration" in modern plants, e.g. the companies seeking to develop and control all phases of manufacture and subsidiary industries, and if possible the production of raw materials like coal.

It should be noted here that a similar organisation of industry occurs in Australia under the direction of the Broken Hill Proprietary Company (see Figure 63).

The non-ferrous metal industries in South Wales. As in the case of the location of the iron smelting and steel industries there are certain pertinent features of historical geography to be noted in the development of the non-ferrous metals industries in South Wales.

Early industrial localisation of the treatment of copper and tin was based upon the importation of ores from Devon and Cornwall to centres like Swansea and Neath. These and their satellite settlements were relatively close by sea across the Bristol Channel, there were navigable streams and an abundant supply of water, adjacent anthracite coalfields, and areas of level land suitable for mill building and expansion.

In the early nineteenth century there was a tremendous increase in the importance of these metals due to the increasing demand for their use in many fast-growing industries. As a result imports of bulk metals began to flow from overseas, e.g. copper from Cuba, Rhodesia and Chile; tin from the East Indies and Bolivia; and zinc from Australia and Burma. Skilled

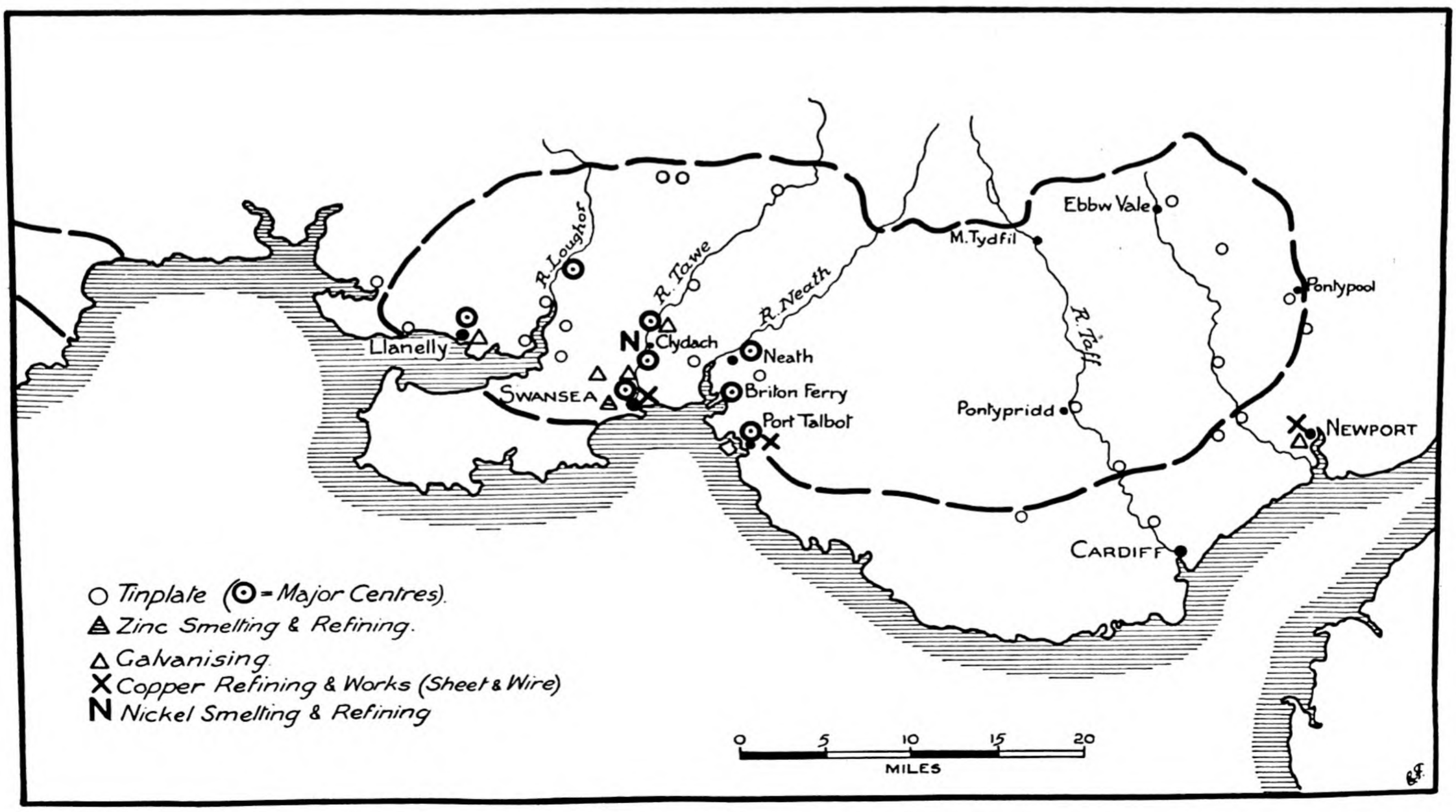


FIG. 25: South Wales: non-ferrous metal industries.

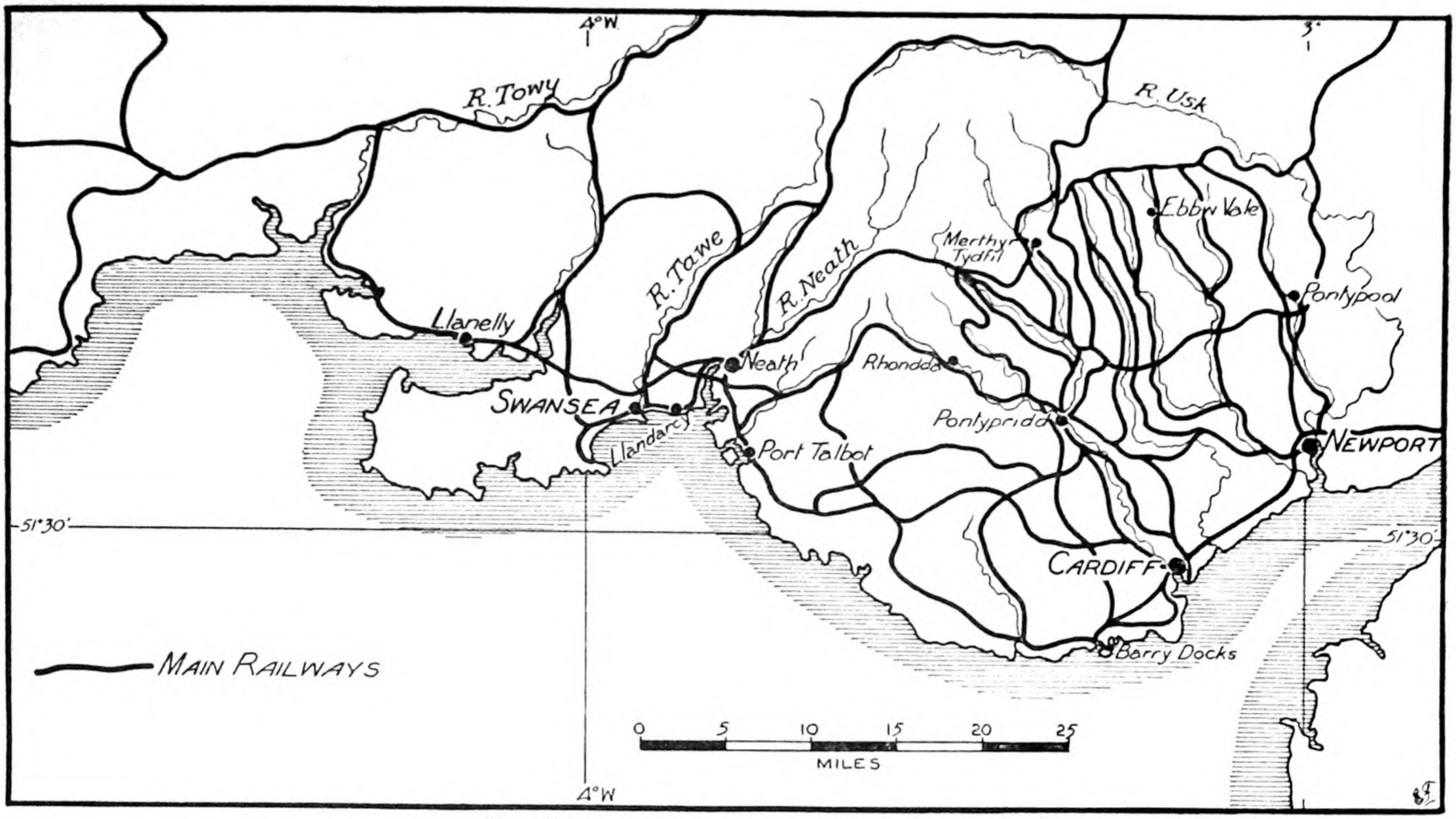


FIG. 26: South Wales: railway pattern.

workers in metal attracted many allied enterprises to the region.

Up to this stage both smelting and refining were carried on in South Wales, but as time went on ore-field smelting increased in the exporting countries, so that by the end of the nineteenth century local smelting ceased, except in the case of lead and zinc. Today copper is imported in a smelted state (matte) and refined only.

A recent development is the smelting and refining of nickel ore from Canada at Clydach, due mainly to the presence of skilled technicians in this area. It is interesting to note that the metal is imported in rather small amounts at a time, being unloaded in the first instance at the principal home port of the British Isles, i.e. London, whence it is sent to South Wales.

Summation of the general geography of metalliferous industries in South Wales. The industrial development of South Wales has proceeded in a relatively small area, about 70 miles by 20 miles. Within this the industries of most importance have been coal-mining, the smelting and treatment of non-ferrous metals, and the production of steel. There is a major combination today of the ferrous and non-ferrous enterprises in the tin plate and galvanising industries, in which thin sheets of steel are coated with either tin or zinc.

South Wales presents a picture of the gradual evolution of a metalliferous manufacturing region developing in an area where abundant fuel supplies were close to iron deposits and tide-water and were reasonably close to copper and tin deposits.

This high degree of specialisation has one serious economic weakness: concentration on only two phases of the industry may create serious depression conditions should the demand for their products fall away at any time. By way of contrast the steel industry of Australia has been built up on a basis of complete diversification of products.

The rail pattern of South Wales. Bearing in mind the facts already touched upon in studies of the previous maps of South Wales, Figure 26 shows

(*a*) the great development of north-south tentacle lines because of the general topography, e.g. the river valley pattern;

(*b*) the function of the rail pattern in linking the coal production centres of the valleys and the processing and export ports of the coastal littoral, e.g. Newport and Cardiff;

(*c*) the contrast between the north-south and the east-west rail nets, emphasising the significance of the coal industry;

(*d*) corridor lines serving the northern towns and the pastoral industries of the uplands.

6

THE TWEED VALLEY

The Tweed valley and surrounding areas. Figure 27 shows the Tweed basin as a compact geographical unit containing a lowland area open to the sea on the east and shut in by encircling hills and uplands which form the watershed of the river and its tributaries. It is bounded on the north by the Lammermuir Hills, on the west by the Pentland Hills and Southern uplands and on the south by the Cheviot Hills, which are on the border between England and Scotland. Notice:

1. The relative location of the Tweed valley to the coalfields and industrial areas of both the lowlands of Scotland to the north and the Newcastle-on-Tyne region to the south. These have had an important bearing, as sources of power, on the modern development of the textile industry in the valley.

2. The rail lines emphasise the somewhat "isolated" position of the valley, but at the same time they are significant in its trading of both sheep and finished textiles.

3. The pattern of township distribution within the valley, both in terms of their historical development as centres in the several tributary valleys, and as points of reference for future discussion of the sub-regional divisions.

Map summary of the geographical features of the Tweed valley. Much of the valley floor as well as the hills was originally forested with oak, birch and pine. This cover has mostly been removed by cutting down and burning off, and replaced by grass or heather.

There is considerable climatic variation in so small a region, a reflection in part of the differences in topography and aspect. In the Merse area, where the land is rarely above 500 feet in elevation, the annual rainfall is generally less than 30 inches and is fairly evenly distributed throughout the year. Here, the climate, topography and alluvial soils are superior to those of the upper basin for crop growing. This is one of the favoured arable farming areas of Scotland even though a large proportion of the produce is fed to animals. The climate of the uplands, with a rainfall of over 40 inches, poor soils, rugged topography and open wind-swept hill tops, precludes arable farming except in a few favoured valley pockets. This region is sheep-grazing country.

Certain aspects of animal husbandry within the valley give rise to a variety of pasture types and live-stock associations. In the upper basins of the Tweed River itself and its tributaries, marked "C" on the map (Figure 28), the farms generally extend from the watershed to the streams, with small patches of cultivated crops on the valley floors. As the minimum pasture area for one sheep during the winter period is at least two acres, the farm areas are rarely less than 1,000 acres and some exceed 5,000 acres. Where the valley floors are wide enough to permit grazing, cattle are also raised. On the whole, the farms are large and almost entirely pastoral in this upland region.

On the hill and valley areas, marked "B" on the map (Figure 28), the valley plains are broader, so that holdings tend to become segregated into

(*a*) lowland farms with arable farming and grass where sheep and cattle are grazed;

(*b*) highland pastures on the higher slopes and summits or interfluves which are essentially sheep pasture farms.

The Merse region, marked "A" on the map, has already been discussed as one of lowland farms with arable crop farming predominating.

Some features hold for all the above areas and are of special significance in the woollen industry:

1. The grazing area includes green pasturage, heather farms and low-ground farms with rotation of grass and turnips.

2. Sheep types differ with each of these. The green pasturage is grazed by the white-faced, hornless Cheviot sheep; the coarser herbage and heather by the hardier black-faced sheep; the lowland pastures by cross-bred types, usually Cheviots or black-faced sheep crossed with larger, earlier maturing Border Leicester or Southdown breeds.

3. The limiting factor of the hill farm is the number of ewes that can be maintained over winter. To keep their flocks within the required limits, the farmers each autumn dispose of the old ewes and male sheep to the lowland farmers, where the ewes are used for breeding cross-bred lambs. The young ewes are added to the permanent hill flocks as they are more suited to the rough pasturage than imported types. Quality is maintained by importing high class rams, often at considerable cost. Thus there is an annual transfer of hill sheep to the lowlands.

4. The hill farm is the real seat of the basic sheep and wool industry, not only of the Tweed, but also of much of Scotland, Wales and northern England.

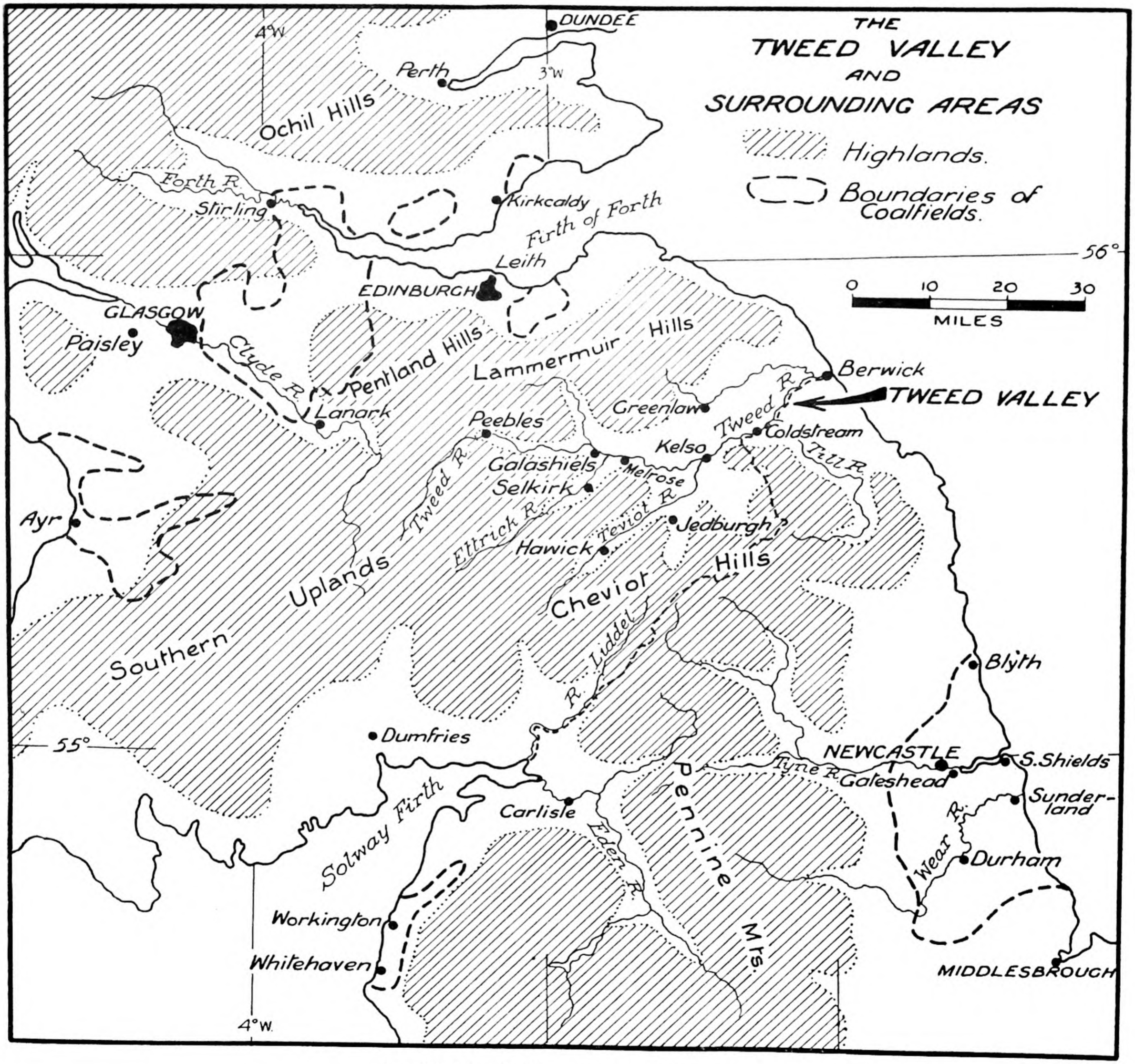


FIG. 27: Tweed valley: general location map.

The development and chief features of the textile industry. The spinning and weaving in the Tweed valley have important historical antecedents the main points of which can be summarised as follows:

In the thirteenth century numerous great abbeys like those of Melrose, Jedburgh and Kelso were founded, and agriculture was developed round them, and spread over the lower ground, which was gradually cleared and fenced. In time the abbeys became the nuclei of small towns to which an influx of Flemings laid the foundation of the weaving industry and fostered trade with the lowlands. Gradually the monks and burghers welded the Tweeddale into an economic unit and gave it the general pattern of grazing, arable farming and woollen manufacturing which it bears today, and which is illustrated in Figure 28.

By the end of the eighteenth century spinning and weaving of wool and linen were carried on both in the houses as a cottage industry and in various towns by guilds. These products became known far beyond Scotland, but a decline in the linen trade set in owing to strong competition from Flanders and Ireland. Although cotton was tried with some success, the advent of machinery gave the weavers of Galashiels, Hawick and other towns of the dales the opportunity to utilise their local advantages and put the wool-spinning and weaving industries on a really effective basis. The most important of these advantages were

(*a*) an abundance of fine and coarse wools from the Tweeddale sheep;

(*b*) plenty of water for power to turn the mill wheels, which were situated alongside swift-flowing streams;

(*c*) soft water supplies (owing to the absence of limestone in the hills) for wool washing and dyeing;

(d) workers with long experience, skilled in the manufacture of high grade materials.

Eventually the industry grew beyond the capacity of the water wheels and its early advantages were lost with the advent of steam and its distance from the coalfields. On the other hand the Yorkshire mills were in a favourable position with respect to their source of power and so provided rapidly growing competition.

To meet this challenge a change was made in the type of manufacture of textiles, from the rough cloths based on the coarse wool of the black-faced sheep to the fine quality checks, derived from the old shepherd plaids and woven from the Cheviot breed. Tweeds became fashionable and gradually established a world-wide market for high class cloths of this particular character.

Some interesting results came from this specialisation.

1. The growing problem of power sources was solved by linking the mills with the electric grid which is here supplied from powerhouses in Northumberland and Cumberland.

2. The increased demand for fine wools led to an increase in the numbers of Cheviot sheep and to the importation of overseas materials, including some from Australia.

3. The industry outgrew the space it was founded in—as is evidenced by the growth of Selkirk—because the valleys at Galashiels and Hawick were too narrow to permit expansion there.

4. Each mill town began and developed associated industries as well as those of textile making. For example, Hawick is famous for its hosiery, possibly the best in Britain, while also producing blankets and tweeds and supporting tanneries. Galashiels has much the same industries, but an additional interest in the manufacture of footwear. Selkirk has tweed and hosiery factories, as has Jedburgh, but Kelso concentrates on agricultural machinery, coach building and the production of fine fishing tackle for Tweeddale's tourists. Melrose is an important market town, and of course is famous for its Abbey ruins (see Walter Scott, *Lay of the Last Minstrel).*

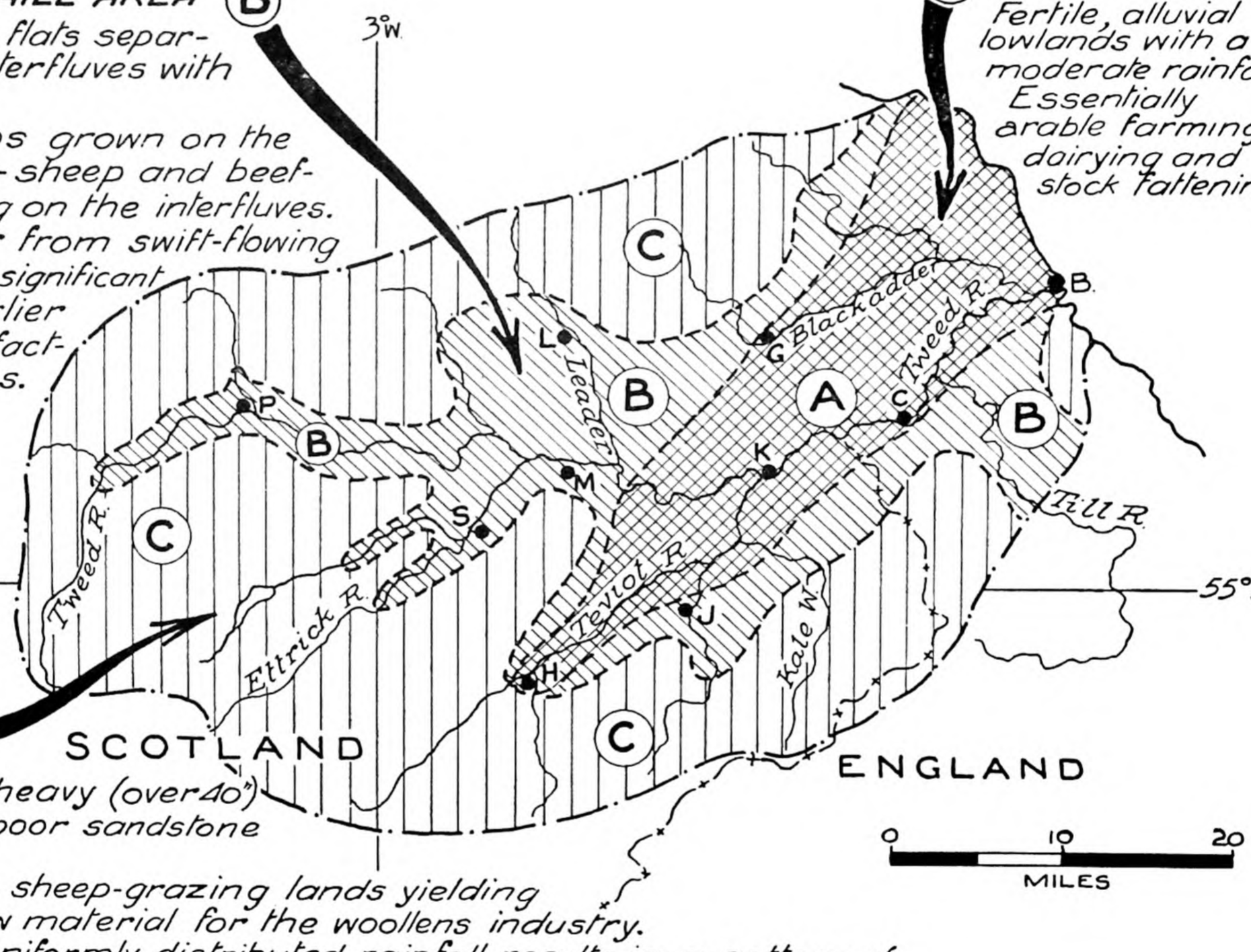
On the whole the Tweed valley textile industry is diminishing. Its continued life is due in a measure to its good access to railways, for the middle Tweed is served by two routes from the north and two from England. These railway facilities have also aided in the building up of important sheep markets in Hawick and Peebles, sales being attended by lamb buyers from many parts of Britain. St Boswell's figures as the leading saleyard for rams of the wool-yielding breeds. The Tweed valley, while losing in the battle of textile manufacturing, is maintaining its place as a pastoral region; there are more sheep in the Basin than in any other area of similar size in the British Isles.

MAP-SUMMARY OF THE GEOGRAPHICAL FEATURES IN THE TWEED VALLEY

(A) THE MERSE
Fertile, alluvial lowlands with a moderate rainfall. Essentially arable farming, dairying and stock fattening.

(B) VALLEY & HILL AREA
Fertile river flats separated by hilly interfluves with poorer soils.
Fodder crops grown on the valley floors — sheep and beef-cattle grazing on the interfluves.
Water-power from swift-flowing streams was significant in locating earlier woollen manufacturing centres.

(C) UPLAND-MOORLAND
Wind-swept moors with a heavy (over 40") rainfall and poor sandstone soils.
Essentially sheep-grazing lands yielding the basic raw material for the woollens industry.



The heavy uniformly distributed rainfall results in a pattern of permanent streams draining into the Tweed. These gave water-power and soft water supplies, which were significant factors in the initial establishment of the woollen manufacturing industry in this area.

FIG. 28: Tweed valley: map summary.

7

THE PATTERN OF A CITY

Generalised activity pattern of a city. Figure 29 shows the generalised zonation of human occupational activities or functional areas as they usually obtain in a city. It is not concerned with precise locations, e.g. a port (Liverpool) or focus of transport routes (Sydney), or with special urban functions, e.g. defence (old cities), manufacturing or agricultural centres (London, Winnipeg), or tourist trade (St. Moritz).

The following comments apply to city structure:

1. The core usually represents the site of early settlement, trade, transport and living.

2. With subsequent growth this core becomes more specialised in the functions of administration, business and commercial activities.

3. The results of this can be seen in the adjacent growth of residential areas with some light industries near by close to which workers desire to be located.

4. An added feature is the focusing of railway and road termini near to if not in the city core.

5. This expansion continues in such a manner that industry becomes more widespread, occupying even some of the older residences and departmental buildings and giving rise to poor residential conditions for those who elect to continue in this area. In short slums appear.

6. Such a zone of social deterioration may continue out even further from the city and light industry core, where heavy industries are adjacent to poorer residential occupance.

7. One outcome of such expansion is the seeking of better home sites and recreational facilities in yet another outer zone.

8. It is at that stage that some evidence of stronger localisation of activities appears, i.e. newer industrial areas on the outer city margin, together with the homes of new workers.

9. Together with this there are suburbs of workers whose tasks still carry them to the city core or thereabouts, known nowadays as "commuters". Such suburbs may have middle or high class residential features, but in either case they call for a great daily concentration of people per railway, tram, car or ferry to the inner urban zone.

10. Railway tracks become especially significant in their transport of raw materials and processed goods to the inner and outer industrial zones. Airports become increasingly important in the rapid handling of both passengers and light bulk goods; their location on the city margin, is of course dictated by a number of factors, not the least of which is the availability of extensive areas of otherwise vacant or useless land.

11. Within all the zones briefly discussed above there are usually some portions of open space devoted to both passive and active recreation. In general, parklands are smaller in the older built-up zones, but with expansion larger areas may be set aside both for present and future use, with safeguards to prevent their being encroached upon by housing and industrial development.

The above shows evidence of evolution from an older central area as the city functions of industry and commerce develop. Such growth is only possible because of greater efficiency in transport, e.g. electric trains and trams taking the place of earlier horse and foot traffic.

This purely hypothetical outline is intended as a guide to future studies of cities, so that students will have some idea of what to look for.

Figure 29 is not drawn to scale, so that in actual cities the three inner zones would be smaller in proportion to the outer residential zone.

Finally, only the major features are shown; their general arrangement and relationships are typical of many cities throughout America, Australia and Europe. Students should see how true this is in their following studies of selected examples of cities.

Functional plan of a hypothetical city. Figure 30 is intended as an application of the diagrammatic illustration described previously in Figure 29, but in this instance it will be noted that it is drawn to scale. Here the zonation of a city on a port location and rail terminus is examined to see how special features may be expected to develop within each zone.

The city core, shown in heavy shading, can be seen to embrace a number of administrative, wholesale and retail trading offices and stores, with accommodation for both daily and dormitory populations in the form of theatres, flats, hotels and tenement houses.

The harbour and railway pattern tends to give the commercial buildings precise locations, e.g. warehouses near the foreshores and railway termini, and banking and insurance firms have ready access to most trading demands. A striking aspect is the tendency towards ribbon development, e.g. with retail stores in marginal suburbs and along main transport routes.

Industrial interests of earlier periods (generally of a light character), together with the poorer standard

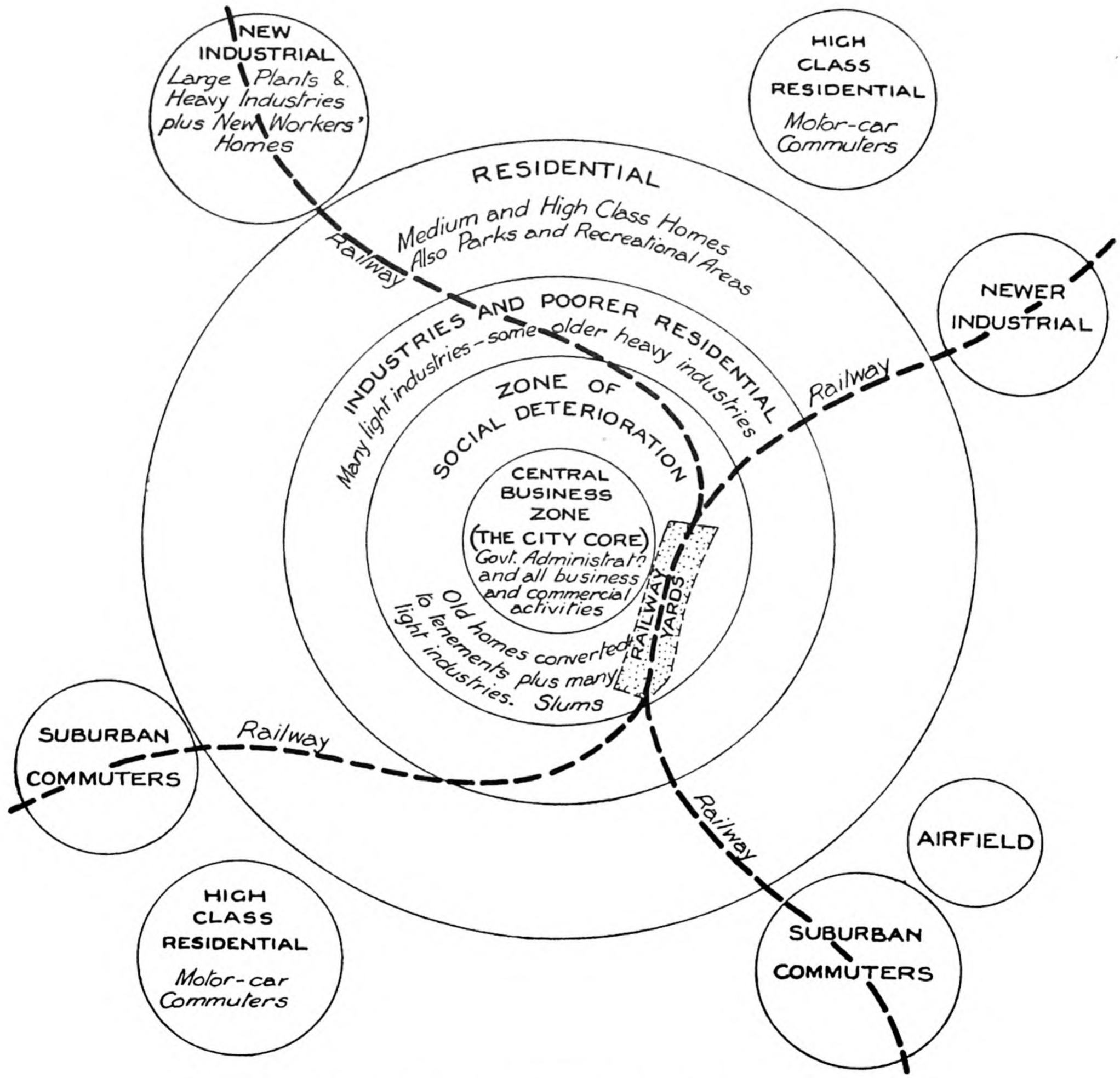


FIG. 29: Generalised activity pattern of a city (After Dickensen).

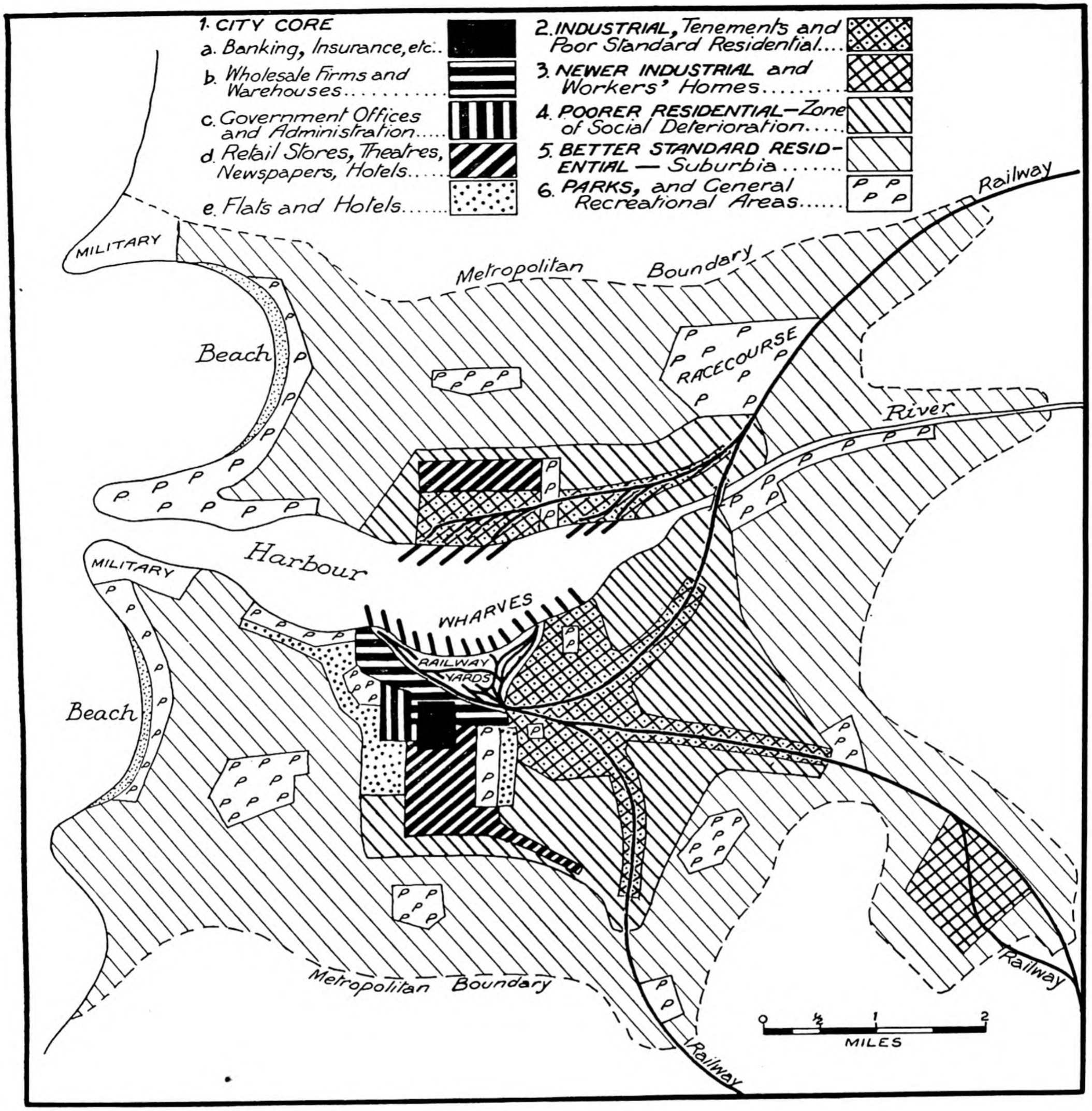


FIG. 30: Functional plan of a hypothetical city.

residential occupance, generally occur in a sprawling manner out from the core, again mainly along transport routes. This zone of factories and old houses reaches out into and becomes part of the zone of social deterioration, where many old-style homes are found crowded into terraces and slowly decaying from age.

Newer industrial and better standard residential areas are marginal to the above, with the newer industrial areas on railway lines.

Open space, especially in the form of parks, for both active and passive recreation, is more in evidence in the outer suburbs. In the city core parks tend to be rather restricted in both area and function.

Defence precautions are in evidence at strategic points, e.g. the entrance to the harbour and river.

Generalised diagram-map of the main functional areas of the Sydney region. Figure 31 shows how a city such as Sydney might be mapped in the light of Figures 29 and 30. For a more precise study of its pattern see Figures 34, 35 and 36. Note here the following features:

1. Development is centralised on Port Jackson,

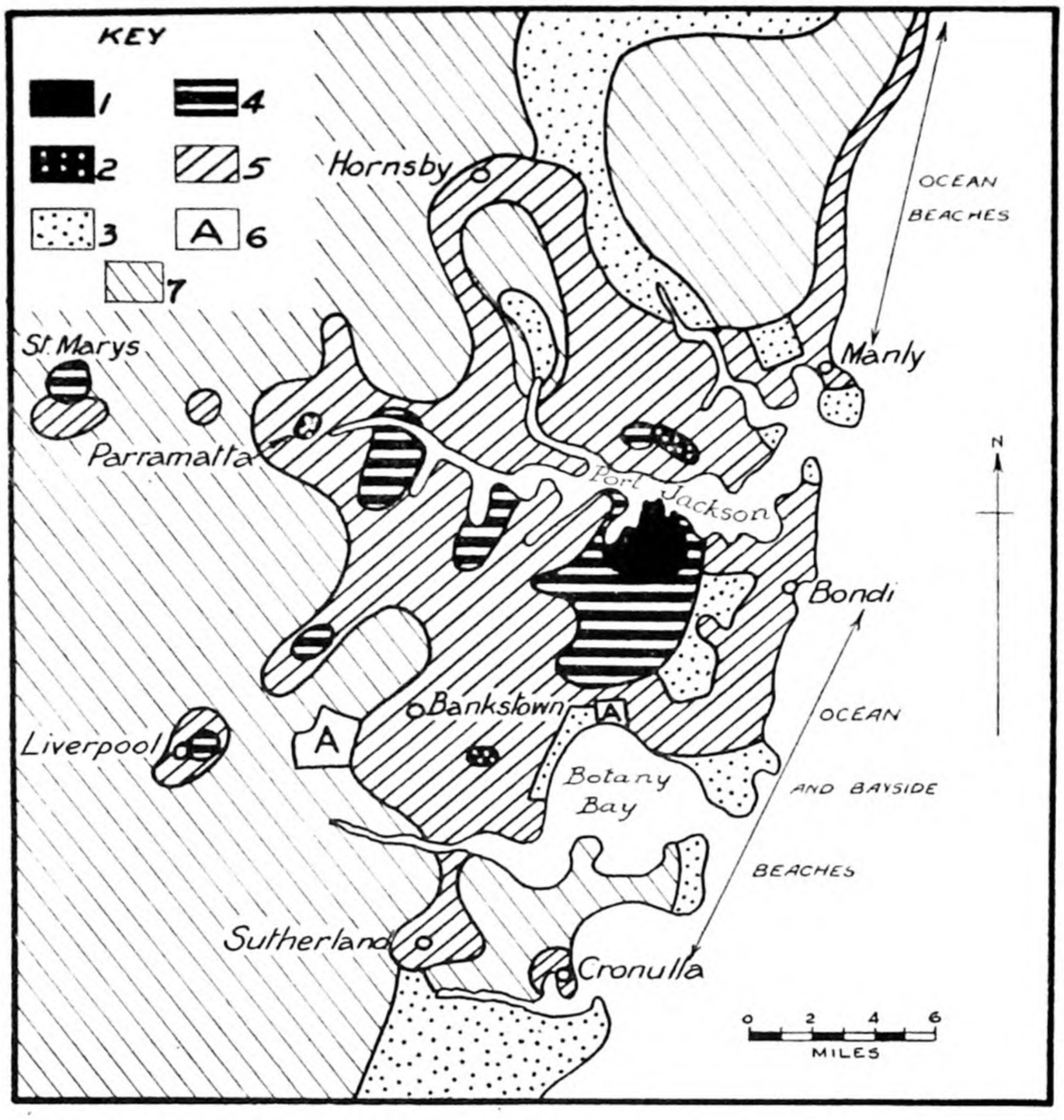


FIG. 31: Generalised diagram-map of the main functional areas of Sydney.
1. City core. 2. Secondary suburban cores. 3. Parks and recreation areas.
4. Industrial (with older residential). 5. Main residential. 6. Aerodromes.
7. Rural industries and bushland.

especially the central southern section, due to certain historical factors and the physical structure of level lowland as contrasted with the more rugged uplands of the northern foreshores. These factors explain the location of the city core.

2. The large secondary cores of Parramatta, North Sydney and Hurstville represent the response to city expansion beyond reasonable transport distance to the central shopping core.

3. Industrial and residential areas illustrate steady expansion over the years on the level and accessible plain of the southern shores. The actual industrial occupance in areas like Clyde, Lidcombe and Homebush Bay (see Figure 33) developed at a relatively early period from large factories situated along the main western transport lines of road and rail. Recent expansion, even in these, has resulted from the demand by firms of the inner zones for larger and more efficient plants. This has given rise to the newer satellite areas of manufacturing at places like St Mary's and Villawood-Liverpool, which have flourished under government encouragement.

4. The residential pattern is more or less a circular one about the harbour with extensions north of Manly and south to Sutherland and Cronulla. An interesting contrast can be made between the restricted building on the ridges of the plateau tops on the north shore of the harbours and the over-all density of the southern side (see Figure 41).

5. Parks, recreation areas and reserves are fairly restricted within the city proper, e.g. the Domain, Hyde and Centennial Parks. Larger public open spaces are to be found on the outskirts, e.g. Kuringgai and National Park.

6. The bushland area and the rural-urban fringe represent sections which have hitherto avoided "building up" and provide room for small farmers who specialise in the growing of "truck" products such as vegetables, poultry, dairy goods, etc. Plans are in hand to maintain this region, together with others, as part of the "green belt" for future Sydney. Portion of this region is also used for the catchment of Sydney's water supply.

7. Aerodrome location and development are significant with Sydney becoming one of the world's great terminals for land and sea planes.

8

STUDY OF A CITY REGION: SYDNEY

Landforms of the region: general. Figure 32 shows the Sydney lowland plain surrounded on three sides by plateau lands and crossed by a series of relatively small streams with slight alluvial plains. The coastal boundaries are made up of the drowned river valley of Port Jackson and shallow bays like Botany Bay. Both here and to the north are coastal beaches and sandhills alternating with headlands.

Detail. 1. Sandstone plateau. (*a*) *Hornsby and Woronora.* (*i*) Although these are classed as plateaux, they are not level uplands but actually a series of long high ridges separated by deep gorges, each formation being in turn a series of smaller branching ridges and deep gullies. They are plateau remnants in an area of severe dissection.

(*ii*) The erosion of the softer top coverings of shales has left the harder Hawkesbury sandstones revealed, but there are still areas of clayey soils on ridge tops like those at Hornsby and Dural. The ridge tops are significant in providing reasonably accessible land for settlement.

(*iii*) In the Kurrajong district these clays are more in evidence and the general appearance of the landforms is not so much that of a plateau as of foothills, spurs and gentle slopes.

(*b*) *Blue Mountains.* (*i*) These lie to the west and are higher, much more rugged and deeply dissected, with enormous canyon type gorges.

(*ii*) They form a definite boundary to the Sydney Plain and were an obstacle to expansion for many years in the early history of the Colony.

As will be seen later the plateau lands, as a whole, are not suitable for extensive industrial and commercial development beyond providing stone, shales and clay for building materials. In some areas the soil (other than the shallow and porous types derived from the sandstone) has permitted limited farming, e.g. Mona Vale and Kurrajong. Small patches have also been developed from eroded materials in the gullies and on the creek flats. The plateau lands are specially suited for residential purposes but in a limited way. They have considerable beauty in their wealth of native trees, wildflowers and bird life and are significant as open space for national parks and tourist attractions. These uplands are valuable as catchment areas and dam sites for water supply because of their unspoilt surface, narrow gorges, seepage through sandstone and flow by gravity. On the other hand communications by both road and rail have been limited, hindered and made costly by the nature of the highly dissected surface.

2. Lowland plains. (*a*) The plains provide a striking contrast with the surrounding plateau lands, being of an undulating surface with gentle slopes and having less scenic beauty.

(*b*) In shape, the Cumberland Plain is most restricted in the east, where it meets the water body of Port Jackson, and is widest on its western boundary of the Blue Mountains. In shape it resembles a flagon with its neck resting on the harbour and its base on the Nepean River. It is covered for the most part by clay soils which are generally hard and stiff and become saturated in wet weather because of their impervious nature and lack of sub-drainage. Although now largely denuded of natural vegetation it can support an open forest type of covering and responds readily to certain forms of re-afforestation.

(*c*) Agriculture is not very productive except on the river flats, where many small farms have been developed to meet the demand for fresh food supplies for the urban areas. Some of the shales permit good orcharding.

(*d*) The plain is of economic significance because its undulating nature permits easy building and spread of settlement. The clays provide bricks and ceramic materials, while a volcanic intrusion at Prospect yields excellent road metals.

3. Alluvial flats and river terraces. These occur on the Cumberland Plain along such streams as the Nepean-Hawkesbury and George's River, which are marked by restricted length, meandering courses, relatively small volume and estuarine tidal influences in their lower courses.

(*a*) Above the settlements of Windsor on the Hawkesbury and Liverpool on the George's River, fresh water is sufficient for local irrigation of the flats but not in such quantities as to develop major sources of domestic water supply.

(*b*) The larger flats, as on the Hawkesbury-Nepean, are the richest primary-producing areas of the Plain because of their alluvial character and ease of cultivation. By way of contrast much of the lower Hawkesbury is rugged and heavily wooded.

(*c*) The level areas along such water sites as the shallow backwaters of Homebush Bay and Cook's River (see Figure 33) are excellent sites for industrial development and the reclamation of land for additional open space.

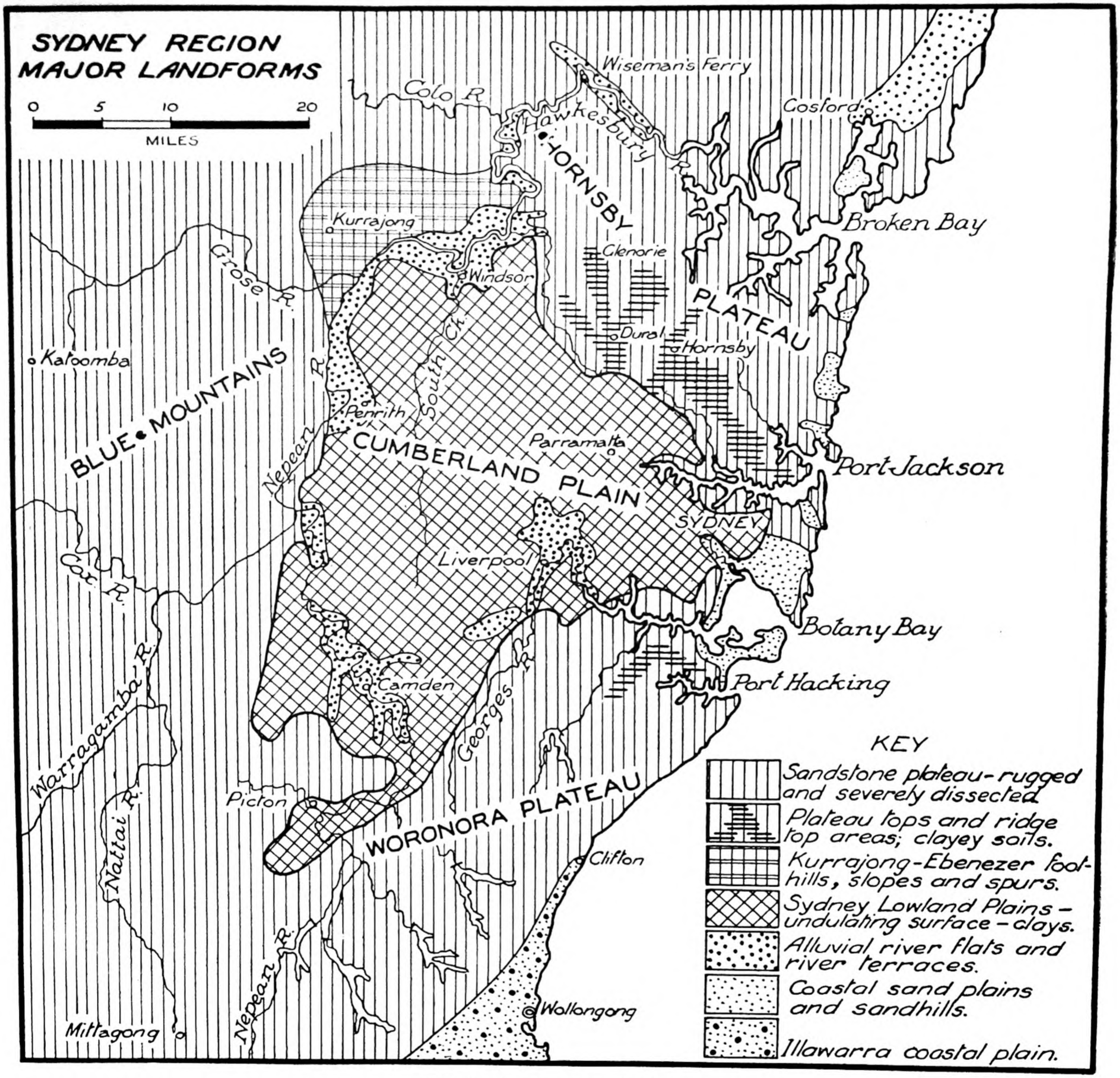


FIG. 32: Sydney region: landforms.

4. Coastal plains and sandhills. These consist mainly of an alternation of headlands and sandy beaches along the main ocean front.

Sandhills are prominent along the Port Hacking and Botany Bay foreshores, whilst here and there, as at Narrabeen, sand-bars have produced lagoons.

The chief headlands, e.g. North Head and South Head and Barrenjoey are particularly striking, deriving their prominence from the fact that they were formerly islands which have since become tied to the mainland by sand spits.

Many of the above coastal features provide settlement areas, recreational and beauty spots for the city population, e.g. Manly, Bondi, Coogee, Palm Beach, Newport.

Port Jackson itself is a section of the plateau region with the eastern extension of the Cumberland Plain

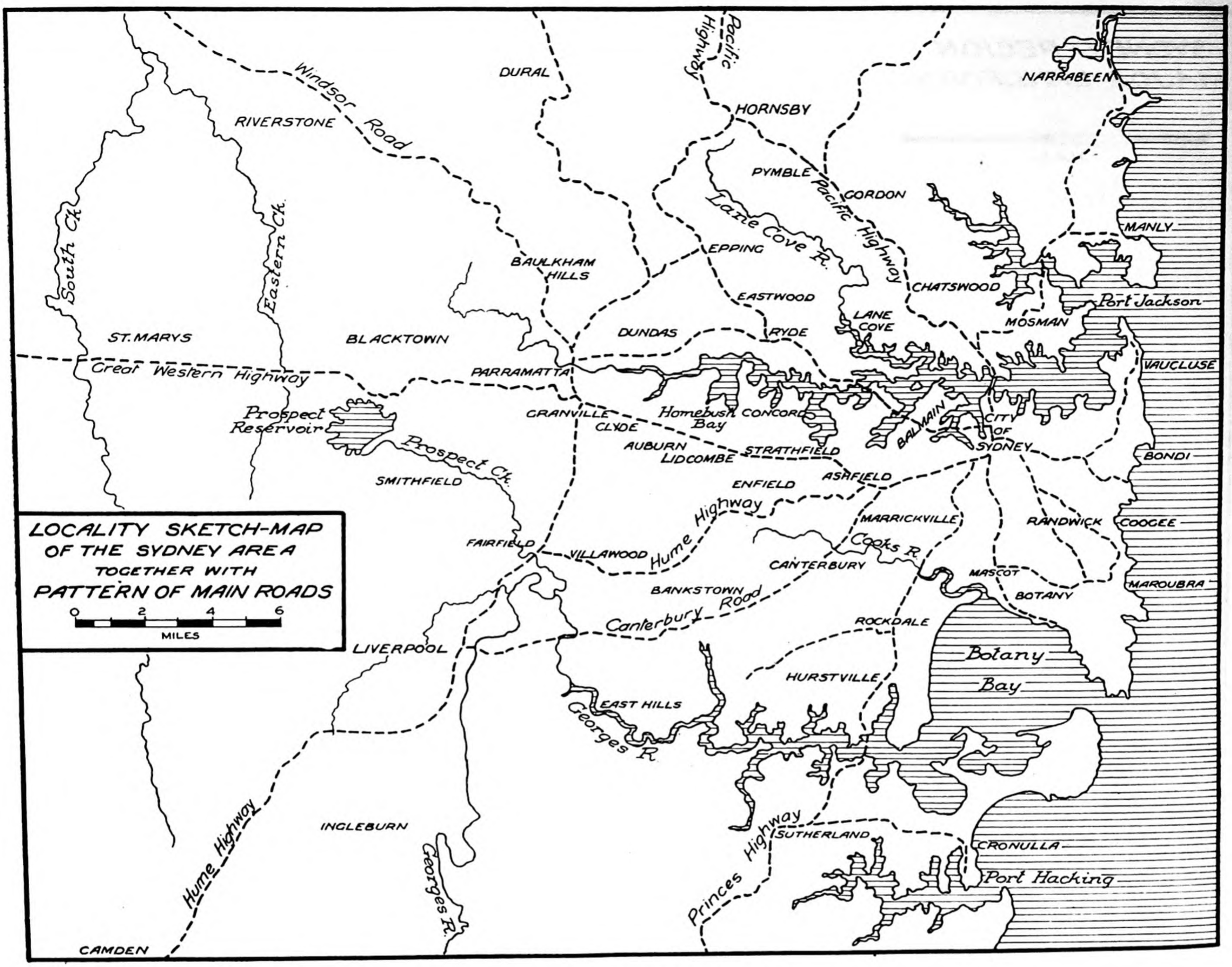


FIG. 33: Sydney region: locality sketch-map.

bordering it, i.e. where the Hornsby plateau flattens out. Its special geographical features include:

(*a*) Depths ranging from 150 feet to 50 feet almost to the shoreline, so that shipping facilities are greatly assisted.

(*b*) Other features which have led to its growth as one of the great ports of the world are its protection from high seas and gales, due to an S-shaped entrance; convenience and protection afforded by many bays and inlets; absence of strong tidal flow; and no discharge of silt by large rivers (the Parramatta and Lane Cove streams are only arms of the great estuary forming part of the harbour). Ships of all draughts can be accommodated in an over-all area of some 13,000 acres.

(*c*) Ships are berthed on the south side of the Port because of the flatter land and consequent greater commercial development.

5. Illawarra coastal plain. This region is worthy of special mention because of its close and important association with the Sydney region. It consists of a relatively narrow coastal plain, marked by alternate headlands and beaches on the coast and backed by steep cliffs and talus slopes on the landward side. Much of the plain which broadens to the south consists of rich soils derived from basalt flows and some of the best dairy farming land of the State is to be found there. Of recent years a great industrial expansion has been in evidence about Wollongong-Port Kembla, where port facilities, local coal resources and land available for reclamation have contributed

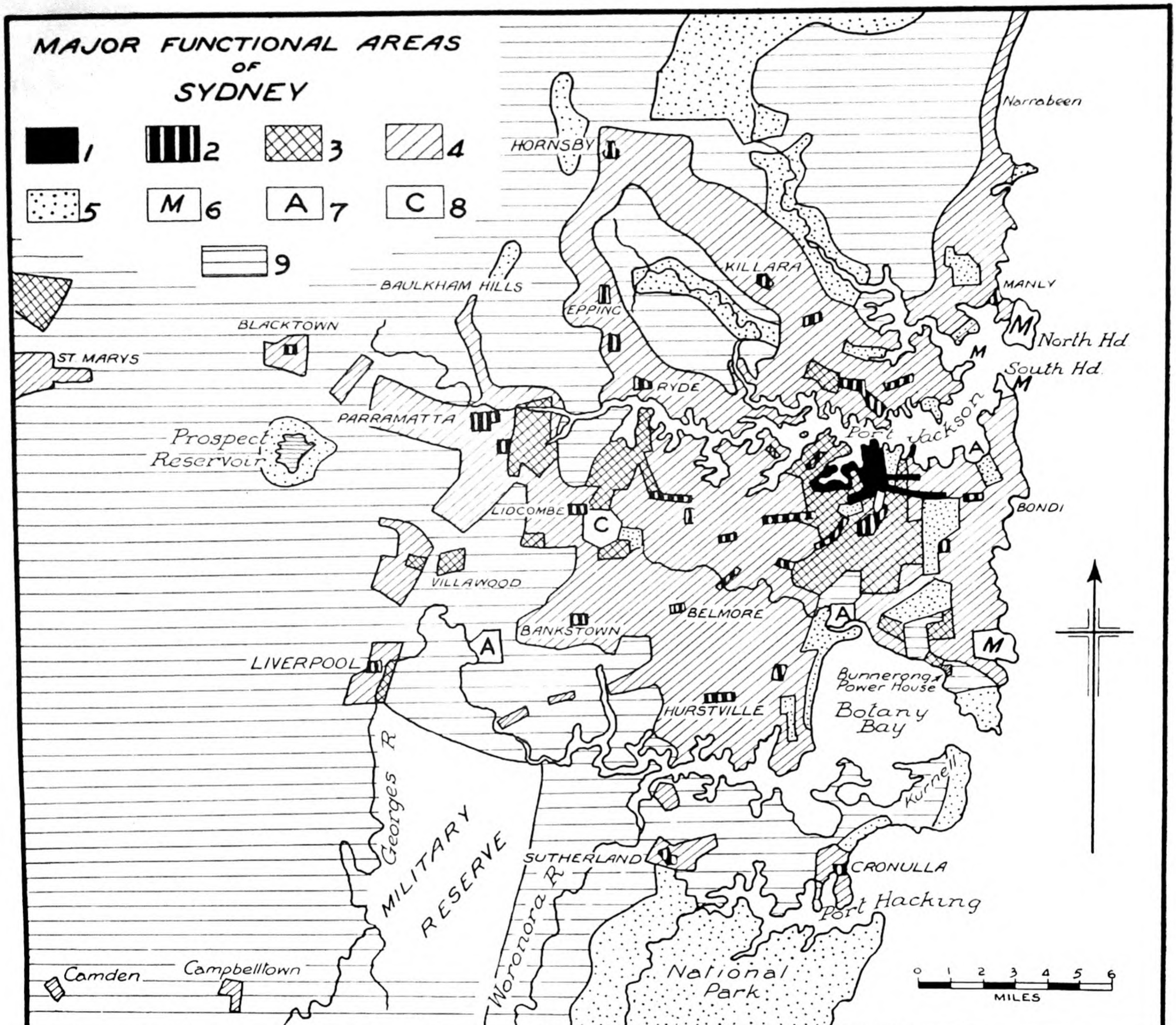


FIG. 34: Sydney: major functional areas. 1. City core. 2. Major suburban commercial centres. 3. Industrial areas (with older residential). 4. Residential. 5. Parks and recreation areas. 6. Military areas. 7. Aerodromes. 8. Main cemetery. 9. Rural and bushland.

towards fast-growing steel industries and associated processing.

This map is basic to all the later studies of the Sydney region and careful reference should be made to it from time to time. In this way it will be seen how much the physical geography of the area has helped to determine the site, expansion and general character of urban settlement.

Locality sketch-map of the Sydney area. Figure 33 is a key to the more detailed examination of the urban geography of the Sydney region, and from its pattern the following should be noted:

(*a*) the major roads and the manner in which they concentrate on the metropolis from all sections of the Sydney area;

(*b*) the location of the main suburbs especially in relation to the port itself; the drainage pattern and the coastline;

(c) the shape and extension of Port Jackson both north-south and east-west; also the other coastal open-

ings of Botany Bay and Port Hacking—all related to communication and the spread of settlement;

(d) the scale of the map so as to estimate relative locations and distances here and in other sketches of the region.

The major functional areas of Sydney: general. Although Figure 34 is somewhat generalised it shows more detail than that of the sketch of Sydney used earlier in the series on urban geography to illustrate the major functional areas of all large cities (Figure 31). The following comments should be accompanied by reference to the key:

1. City core and commercial centre. This section is made up of bulk and retail stores, banking, and insurance, private and public administration, many light industries, accommodation and entertainment, (hotels, restaurants and theatres), with a small dormitory population.

2. Major suburban commercial centres. Reference to the map of the suburban and transport patterns (Figure 33) will show how these centres have grown up along highways serving a dense population of which many people are daily travellers to factories or city offices. The best examples are to be seen along the main western roads. Smaller centres occur on the northern side of the harbour.

3. Industry and residential. Industrial sections include both heavy and light types which are described in detail in Figure 36. There are certain important localisations, e.g. marine, heavy and storage on the foreshores; light manufactures adjacent to the city core and rock structure, i.e. brick making; planned satellite factories, e.g. St Mary's. Near these industries are residential areas to house workers, the oldest ones being those which represent the first attempts to house employees in or near the heart of the original settlement, e.g. tenements of Redfern.

4. Residential. Although these areas are shown by the one type of shading, there is considerable variation according to location, e.g. the slum section close to the city proper; the flats of King's Cross and eastern suburbs where there are also exclusive home sites; the better class homes of the western suburbs and north shore, with newer sections being opened up in the Bankstown, Sutherland and Epping-Hornsby lines.

5. Parks and recreation areas. These comprise the inner group of city parks, e.g. Hyde Park, Botanical Gardens and Domain; an outer group like Centennial and University Parks; sports and exhibition grounds like Moore Park and the Showground. Marginal to these are the watering places of the famous Sydney beaches and the recreation and scenic preserves of National and Kuringgai Parks.

6. Military areas. These are made up of land set aside for coastal defences, military stores and training. They do not take up much space, but are selected and used for their particular strategic values, e.g. North Head and Middle Head.

7. Aerodromes. These vary according to demands and special functions, although their initial sites were determined by the need for fairly large areas of otherwise poor land. The main airfields are at Mascot (Kingsford Smith) which is the terminal for many interstate and overseas civil airlines; Bankstown, an Air Force and constructional centre, and Rose Bay, the terminal for flying boats.

8. Main cemetery. In early years of settlement there were several small burial grounds, but with the spread of the built-up parts of the city a movement was made into the outer suburb of Rookwood where a single large section of land was dedicated. Most of the original suburban grounds are reclaimed or closed, but in certain areas crematoria have been set up, e.g. northern suburbs.

9. Rural and bushland. This includes the small farming of the Cumberland Plain interspersed with light bush. The more rugged bushlands are found on the plateau lands already described in the map of the landforms (see Figure 32).

Inner city area of Sydney. Figure 35 illustrates the close segregation of many of the city's major functions in its inner area. The divisions are twelve in number corresponding to the key of Figure 35:

1. Commercial core and Government administration. This is, in part, the result of the gradual evolution of land occupance from the early days of government by military and naval authorities, who, of necessity, set up their headquarters on the Harbour foreshores.

(*a*) Its site also arose from the demand for a permanent supply of fresh water, which came from the Tank Stream near by. Food supplies of the early settlements were significant here, too, being landed from the ships, and supplemented by attemps at local cultivation in such spots as the present Botanic Gardens, Farm Cove and Parramatta.

(*b*) Early overseas shipping, especially that concerned with the export of the first wool bales, led to the establishment of wharves and bulk stores at Sydney Cove and Miller's Point.

(*c*) The necessity of foot travel in the first stages

of settlement led to the setting up of customs, insurance banking and shipping houses within easy reach of the growing harbour facilities.

(*d*) Reaching out from this centre of early administration, there came into being a series of buildings concerned with the functions of the Government of the State, i.e. Public Works, Lands, Education. Postal, all handy to the Treasury and Parliament itself.

(*e*) Not far from these rose the Law Courts, with legal offices (Phillip St), Sydney Hospital, with medical offices (Macquarie St) and the cultural units

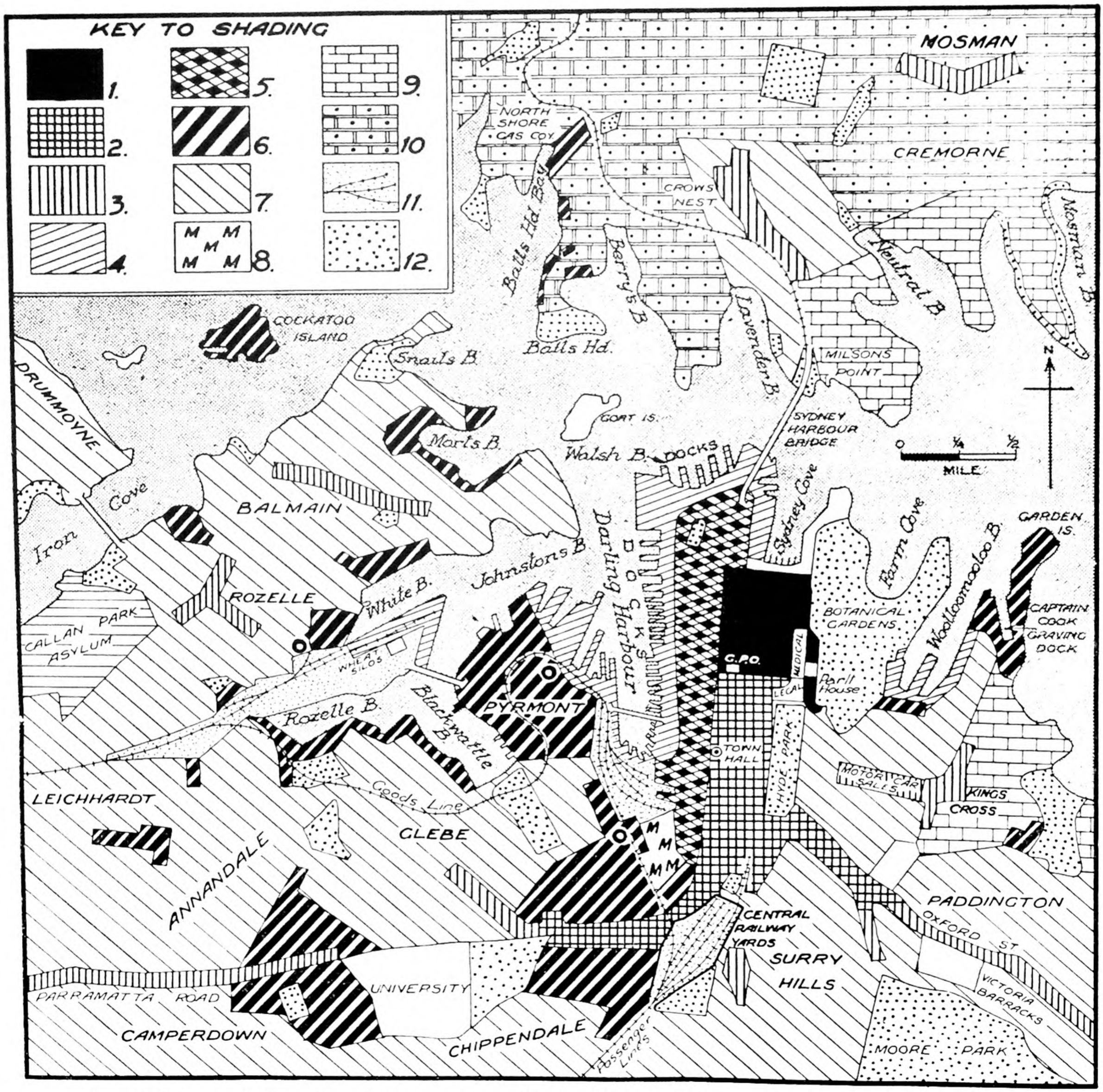


FIG. 35: Sydney: activity pattern of the city core. 1. Commercial and administrative core. 2. Main retail centre. 3. Subsidiary shopping centres. 4. Dockland. 5. Main wholesale trading centre. 6. Industrial areas. 7. Industry and poorer residential. 8. Wholesale food markets. 9. Residential (flats). 10. Residential (middle class). 11. Railway and goods yards. 12. Parks and open spaces.

of the Art Gallery, Public Library and Conservatorium of Music set in parklands, the Botanical Gardens and Domain.

(*f*) Today much of the former harbour, offshore from the above pattern derived from Government activities, has developed into a Fleet Reserve consisting of the Garden Island Graving Dock area with adjacent Woolloomooloo Bay, all devoted to the repair and revictualling of naval units.

This core of official administration now includes many private head offices associated with shipping companies, banking, insurance and exchange activities, their location being determined in part by both past history and present geography of trade and commerce.

2. Retail shopping centre. Early trading premises were erected in close proximity to the government offices and shipping docks.

(*a*) With the growth of the township they also tended to line the street as planned by the early governors and their surveyors to run mainly south and then westwards.

(*b*) In order to meet the demands of these shops for goods other than those directly imported, light industries began to appear in the vicinity, together with newspaper offices.

(*c*) Side by side with the retail and industrial trades there appeared places of amusement (theatres), accommodation (hotels and boarding houses) and eating-houses (restaurants).

(*d*) At the present time these functional units occupy much the same location, following the axis of the first buildings from the ferry terminal south 1½ miles to Central railway station, with a width of about half a mile. Here are the principal streets of the metropolitan area, with ferry, tram, train and bus transport converging on a small radius within the central city. The main retail shopping section is to be found in several streets, the most important of which are George, Pitt and Castlereagh streets.

3. Subsidiary retail centres. Radiating outwards from these shopping lanes are several retail sections lining the major highways, e.g. Oxford St and Parramatta Road, because of the restricted size of the central core and its limited functional capacity. They supply the dense populations of the inner suburbs, e.g. Glebe, Camperdown and Darlinghurst. On the northern side of the Harbour are busy centres at places like Crow's Nest and Mosman.

4. Dockland districts. Figure 35 shows these to be arranged roughly in a series of zones according to the nature of the trade, historical development and locality best suited to its special functions. As a general result they have very close relationships with industrial, commercial and transport activities, and in recent years the demands upon them have been very great. To meet these the controlling authority of the Maritime Services Board has proceeded with a long-range policy of providing much mechanised gear, while re-conditioning many wharves and reclaiming harbour foreshores for others.

At present the major dockland districts may be zoned as follows:

(*a*) The east side, consisting of Darling Harbour and Walsh Bay, which are adapted to handling general cargo and passenger traffic by overseas and coastal shipping. Important features here are the deep water, many wharves of the jetty type, two-storied storage sheds, mechanical equipment, and closeness to rail and road lines.

(*b*) The west side, e.g. Johnston's Bay and White Bay, where as well as the features already enumerated above, there are extensive railway yards and warehouses handling in the main bulk commodities like wool, bagged wheat, lumber and coal.

(*c*) Special areas like Glebe Island, a peninsula of reclaimed land in Johnston's Bay, handling bulk wheat in 7½ million bushel silos. Here are the best railway marshalling yards for the seasonal movement of foods like meat, flour and butter.

(*d*) Other special areas such as Pyrmont for colliers, Jones Bay for meat, Sydney Cove for ferry traffic, Mort's Bay and Cockatoo Island for shipbuilding, and Woolloomooloo Bay for general overseas and naval shipping. Wharf facilities are also available about the harbour for industrial purposes (see Figure 36) and the handling of products such as sugar (Pyrmont), oil (Ball's Head Bay) and lumber (Rozelle Bay).

5. Wholesale trading centre. Wholesale and warehouse establishments are grouped largely on the west side between the retail shopping and the dockland areas. They are bounded by Sussex, Kent and Clarence Streets and have a close relationship with wharves at Walsh Bay and Darling Harbour as well as the railway goods line terminating there.

(a) In earlier periods the position of such buildings was further towards the Sydney Cove section, but need for more docking space and the growth of the retail and administrative parts of the city forced them to the western side of the peninsula.

(*b*) Today, with the need to handle large quantities of goods in bulk, this is a highly advantageous location, the distance of transport being small both from ship to train to warehouse, and from there to the shops and small factories in the city.

(*c*) Evidence of the somewhat limited storage and transport needs of previous times is to be seen in the tall sandstone buildings in the narrow streets which were adapted in the first instance to horse drawn vehicles.

6. Industry dominant. Although the industry pattern for Sydney as a whole is treated again in Figure 36, certain special features of it are to be noted with respect to the distribution illustrated here:

(*a*) It is all associated with lighter kinds of activities, e.g. processing and storage, much of which has close association with the dockland area as already pointed out.

(*b*) The industries form a fairly compact series of plants linked with commercial activities in their neighbourhood, and so are not scattered amongst older residential sections, as will be seen in the case of other industries to be mentioned below. As an example, Pyrmont contrasts with Glebe.

(*c*) A certain specialisation is found in the various localities, e.g. shipping repairs etc., at the Garden Island-Captain Cook Dock centre, sugar and fibreboard manufacture at Pyrmont, saw-milling and timber depots in Blackwattle Bay, cold storage, treatment and despatch of perishable foods at Ultimo, spinning mills at Camperdown and wheat storage at White Bay.

(*d*) In addition to the above are those somewhat smaller areas devoted to the manufacture and/or storage of fuels, e.g. coal and gas at Ball's Head and the adjacent bay, petroleum in Berry's Bay and electricity at White Bay.

7. Industry in older (now poorer) residential area. This is fairly widespread and extends in a wide area from Balmain through Annandale and Chippendale to Paddington.

(*a*) These industries in most cases owe their position to earlier establishment when the city was smaller and are mainly interspersed with poorer residential and tenement buildings, the zone of social deterioration.

(*b*) Apart from the larger concerns like breweries, jam and other processing units, the industries are of the smaller type, e.g. footwear, clothing, light machinery and repair depots.

(c) Their location places them close to the wholesale and retail zones and so the problem and cost of transport are relatively small.

8. Wholesale markets. These have been established for the handling in the main of the wholesale trading in fruit, vegetables, flowers, poultry, fish and dairy produce.

(*a*) Since much of the produce is of a perishable nature, there is a close link with large storage concerns, e.g. the Fresh Food and Ice Company, Dairy Farmers Co-operative Society and Sydney Cold Stores.

(*b*) Goods are brought in bulk to the central markets by rail, ship and truck from all parts of the Cumberland Plain, as well as from State and interstate regions; dispersal to the many small retailers is mostly by truck. This involves a tremendous daily movement in and out of the city, but most of it takes place at times when the traffic is light. Nevertheless there are plans to attempt to disperse this concentration into suburban centres in the future.

9. Residential areas with flats dominant. These represent the most densely populated parts of Sydney, e.g. King's Cross, and, on the north side of the harbour, Milson's Point. The significant features are:

(*a*) The types of buildings, which range from huge blocks of flats to converted private residences, built along the harbour in more spacious times, especially on the north side, which was once exclusive and had pleasant ferry transport.

(*b*) They are occupied by people who are working daily in or very near the city core, and who naturally desire fairly cheap and fast transport.

(*c*) Associated with them are numerous small businesses, e.g. delicatessens and clothes cleaners.

(*d*) In recent years government-sponsored schemes have attempted to meet the demand for this type of housing by erecting large building blocks with accommodation ranging up to 300 units as at Milson's Point.

10. Residential areas—mostly middle class. These occur almost wholly on the north shore. The main reason is that that part of the city did not offer the location and advantages for trade and commerce of the southern shores, and at the same time was a pleasant respite from the centre of business. Today, the interesting geographical aspects are:

(*a*) existence of many older type of residences near the water's edge with newer homes and flats on the higher ridges;

(*b*) adjacent retail sections, e.g. Crow's Nest, which have become increasingly important with more costly transport to the city;

(*c*) conversion of older homes to flats and the movement of their former owners to the higher bushland suburbs further along the line, e.g. Lindfield, Killara, Gordon, Pymble.

11. Railway termini and goods yards. These are concerned with both the handling of goods, i.e. Darling Harbour and White Bay, and the transport of passengers, i.e. Central Railway. Of these specialised activities it can be said that

(*a*) the goods traffic tends to be concentrated on the areas of the harbourside industries and dockland, with considerable bulk handling, e.g. wheat;

(*b*) the passenger lines terminate (steam trains) close to the retail area and administrative offices, private and government;

(*c*) the electric railway system, of which the underground section is not indicated here, handles

—SYDNEY—

THE PATTERN FROM INDUSTRY

0 1 2 3 4 5 6 7 8
MILES

KEY

1. THE INNER AREA:

(A) WATERSIDE INDUSTRIES:
Shipbuilding, docking & repairs; Sawmills and joinery; Soapworks; Sugar refining; Oil storage and refineries; Flour mills; Engineering.

(B) LIGHT INDUSTRIES MAINLY
Engineering workshops; Motor-car repairs; Food & drink; Printing; Clothing; Furniture & bedding; Drugs & chemicals; Scientific instruments; Leather goods.

(C) OLD HEAVY & NEWER LIGHT INDUSTRIES
Machine shops & engineering workshops; Foundries; Glassworks; Textile mills; Papermills & Paper products; Pottery, tiles, bricks; Food preserving (esp. meat & jams); Boots & shoes.

(D) OLD OBNOXIOUS & NEWER HEAVY INDUSTRIES
Tanneries & wool-scouring; Paper-mills; Textile mills; Aeroplane manufacture & maintenance; Metal work & machinery.

2. THE OUTER AREA:

HEAVY AND/OR EXPANSIVE INDUSTRIES:
Abattoirs; Railway rolling stock & workshops; Agricultural machinery; Rubber tyres; Steel mills; Electrical machinery; Earth-moving equipment; Asbestos sheets; Oil-refining.

3. RIBBON DEVELOPMENT:
ALONG ARTERIAL ROADS.

4. SATELLITE AREAS:
Mostly new—to encourage decentralization

RAILWAYS — ROADS
GASWORKS ELECTRIC POWER STATIONS

HORNSBY
DEE WHY
Pacific Highway
Lane Cove R.
EPPING
CHATSWOOD
CARLINGFORD
BLACKTOWN
SEVEN HILLS
Parramatta River
ST. MARYS
PENRITH
Great Western Highway
WENTWORTHVILLE
PARRAMATTA
RYDALMERE
RHODES
BRIDGE
GRAVING DOCK
CRANVILLE
CLYDE
AUBURN
LIDCOMBE
Prospect Reservoir
BURWOOD
ASHFIELD
REDFERN
CHULLORA
ST PETERS
Cooks R.
SYDENHAM
VILLAWOOD
Hume Highway
CABRAMATTA
BELMORE
BANKSTOWN
WILEY PARK
PUNCHBOWL
ARNCLIFFE
LIVERPOOL
Georges R.
KOGARAH
Bunnerong Power House
Botany Bay
HURSTVILLE
EAST HILLS
Georges R.
SUTHERLAND

FIG. 36: Sydney: the pattern from industry.

an enormous number of travellers daily, both to and from as well as through the city; *and*

(*d*) the extension of this service to the eastern suburbs should do much to relieve present traffic congestion in those areas.

12. Parks and recreation areas. The following features make these significant for the inner area of the city:

(*a*) The comparatively small areas of parks and recreation grounds, due to past mistakes in planning and the unfortunate encroachment of buildings on areas already set aside as open space.

(*b*) The limited sections of harbour foreshores, even on the northern side, which can be utilised to public advantage. This should be contrasted with the advantages taken of such a site in the city of Rio de Janeiro.

(*c*) The contrast amongst the areas of open space between those parts capable of active recreation, e.g. Moore Park and Glebe and those useful only for passive recreation, e.g. the Gardens.

(*d*) The cost and difficulty of future planning to give adequate open space in terms of modern findings. As it is, considerable pressure is being exerted to reduce what small areas are at present available, e.g. the attempts to resume even Hyde Park and the Domain for parking space.

Sydney pattern of industry. The following features are evident from Figure 36:

1. The manner in which the industries are confined almost exclusively to the flatter southern side of Port Jackson with well-marked zones of considerable area spread and ribbon development. By way of contrast the activities of the North Shore are confined almost entirely to the arterial roads along the plateau ridges.

2. The major divisions of the industries into an inner area, an outer area, satellite areas and areas of ribbon development. The various types of manufacture and processing listed in the map key should be studied very closely in order to appreciate the geographical factors that have helped to determine their particular localisation.

3. The obviously strong relationships between industry and the shape and character of the harbour, as well as the pattern of road and rail communications.

The main determinants of the present distribution and character of Sydney's industries may be summed up as follows:

1. Landforms. In the study of the landforms map of the Sydney region it was pointed out that the topography of the southern foreshores provided a comparatively level area of plain reaching to the water's edge. As a result industrial development and expansion occurred for the most part on land under approximately 100 feet elevation.

2. Harbour pattern. The first developments in industry took place in suburbs adjoining Sydney Cove and Darling Harbour areas where export facilities were significant in the growing colony with its emphasis on trade in the products of the land. The spread from these points was in the direction of Glebe, Redfern and Surry Hills, with Pyrmont and Balmain becoming docking and wharfing centres. Secondary industry also needed harbour sites as time went on, in order to secure ready access to raw material supplies. As a result many large industrial units are located near the water today, some of the most important being the Colonial Sugar Refinery, Lever Brothers soap works, many saw-milling plants with their associated furniture and joinery factories, gasworks, Lysaght's Galvanised Iron and Wire Works, and linseed-oil refineries.

3. Railway pattern. The growth of industries in other suburbs was associated in large measure with the expansion of the railways, the pattern for the whole State centering on Sydney. This encouraged the setting up of many factories to process the products of the hinterland for both local use and overseas export. Examples of this can be seen in the number of plants situated about the Clyde marshalling yards, the State Abattoirs at Homebush and the many large flour mills in the city and suburbs.

4. Power sources. In the early stages of industrial development power for use in the individual factories was derived from Newcastle coal. Nowadays it is obtained from coal, coal-gas and electricity generated by coal and oil. This essential manufacturing agent is now being used to the limits to meet the requirements of the greatly expanded post-war industry of the city.

5. Water supply. Although this has been ample since 1920, prolonged droughts, as in the late thirties, and the rapid increase in post-war industries have made effective supply difficult from time to time. But the expansion of distribution mains and the completion of the large Warragamba Dam should alleviate the position for good.

6. Labour supply. As the principal port of entry for immigrants Sydney received a steady flow of industrial workers, and these, together with the numbers who drifted to the city from the country as farming became increasingly mechanised, formed a pool of labour sufficient to meet the demands of industry and commerce within the city. The post-war policy of introducing thousands of new workers from other lands has meant a gain both in the numbers available to industry and in the technical skill needed for most modern trades.

7. Capital. Money for investment in industries has always been in sufficient amount, except during the depression years of the thirties; and lately there has been a considerable influx of overseas capital to be used in establishing large branch factories here, e.g. motor assembly plants. This has been strongly fostered by governments, whose policy since World War I has been one of protecting local industry by the imposition of high tariffs on imported goods which could be made locally, and since World War II one of prohibiting the outflow of dollar money earned within this country.

Present distribution. Figure 36 shows that there are four major types: the inner area consisting of areas A,B,C,D on the map; outer area of the western suburbs; the satellite areas; and the ribbon development on the major transport routes.

1. Inner area: A on the map. Industries here derive their character mainly from activities peculiar to the waterfront, i.e. either the building, repair and supply of shipping or the storage and processing of bulk foodstuffs and raw materials brought in by ships or destined for overseas export.

B on the map. (*a*) Here there are about 3.000 factories, mostly small and with few actual factory buildings as generally understood, because of the very nature of the undertakings. The main exceptions would be engineering workshops, especially those connected with the motor-car trade.

(*b*) The greater proportion of industry is actually located in those buildings originally designed for commerce and office accommodation. Many small factories occupy rooms in the same buildings as offices and/or government departments.

(*c*) Many of these locations have become unsuitable because of out-of-date buildings, declining labour supply due to traffic congestion, extended hours of travel and the spread of new dormitory suburbs to outer sections of the city. The over-all result has been that the larger and expanding industries of the inner city core are steadily migrating to more favourable sites.

C and D on map. (*a*) In this inner suburban area in 1945 some 58 per cent (142,000) of the factory workers of Sydney were employed. Every class of industry is represented with the bulk of the metal and engineering plants in Alexandria, Waterloo and Redfern and southwards from there to St Peters, Rosebery and Mascot.

(*b*) Textile and clothing mills are dominant in Marrickville, though there are many of this type of factory scattered throughout the whole area; and glassworks, earthenware and brick works are found in Waterloo, Alexandria and St Peters.

(*c*) If an extension of the limits of these areas is made they can be said to include the principal electric power stations, including Bunnerong Power House, and the concentration of sawmills, furniture and joinery works.

(*d*) Food factories (including all the breweries) are dispersed throughout the area, while paper mills, wool-scouring, fell-mongering and tanning works are found in the Botany area where the necessary soft water is obtained largely from the Botany swamps.

(*e*) Newer industries in this section include plants for aeroplane manufacture and maintenance and motor-car assembly plants, e.g. the General Motors plant and the recent Nuffield plant on Victoria Park racecourse.

(*f*) Recent expansion has occurred on the previously unfavoured areas of sandhills and swamp through Mascot and Botany. As a result the attractive single-storied and well-designed and well- appointed factories in many parts of this area contrast sharply with the appearance of the older establishments throughout Alexandria, Waterloo, Newtown, Chippendale, Rozelle and Balmain. In part this development of new industries has been accomplished at the expense of the old market-gardening lands in the Botany-Mascot section, which have now migrated to the rural-urban fringe beyond Parramatta.

(*g*) Further industrial development in this area will be affected by available and potential transport services, since the present capacity of the roads has nearly reached saturation point. Already nearly 50 per cent of the labour is drawn from far beyond the inner suburbs and much of the raw material has to be hauled from distant railyards on roads rarely designed to carry heavy motor transport. The building of a goods yard at Tempe may ease this position.

2. The outer area. This area extends through the western suburbs from Rhodes to Parramatta and south to Regent's Park.

(*a*) Some 37,000 workers (about 15 per cent of the total) are employed here. The metal industries are generally predominant, though the Mortlake Gasworks, Homebush Abattoirs, oil refineries, sheet asbestos and rubber works are also worthy of notice.

(*b*) Large expansive single-storied factories occur here more frequently than elsewhere, except perhaps in the Mascot area, since land space is more plentiful and land costs lower than in the inner suburban area and city core.

(*c*) Access to rail transport is easy, as the area is crossed by the main goods traffic line from Lidcombe to Darling Harbour.

(*d*) The dredging and deepening of Homebush Bay, at present being undertaken by the Maritime Services Board, will provide much of the area with suitable water access, and at the same time make much land available along the foreshores, where the dredged

material is being dumped to fill in former swamp-land.

(*e*) This area also contains the major railway workshops at Chullora and several plants devoted to the manufacture of railway rolling stock, trams and buses for the city transport services. It also has several very large electrical equipment manufacturing plants and, beyond Parramatta, there are some large, new textile mills.

3. Ribbon development. The vital need of industry for quick access to arterial roads has led to the development of factories along, or near to, several of the main highways radiating from the city core. These are indicated on the map as No. 3 types and occur principally along Parramatta Road, Prince's Highway, Canterbury Road and the Pacific Highway. As this is a comparatively recent development in factory location, many of the buildings are large and modern, although those nearer the inner industrial parts are older and smaller.

(*a*) The growth along the Pacific Highway and feeder roads to it from Milson's Point to Chatswood and Roseville has occurred largely since the Harbour Bridge gave easier access to those suburbs.

(*b*) Development has been limited by two factors: one the unwillingness of many of the municipal councils to allow factory penetration of their suburban areas, the other, the restriction of flat land on which to build.

(*c*) This was a fairly densely settled area and factory sites have in recent times had to be found on high-priced land, hence development has been confined to the light industry group, which can use the surplus labour of the nearby residential suburbs. As this surplus was mostly female labour from better-class residential sections, this growth also affords an interesting example of industry moving to the labour supply.

(*d*) Recently there has been some factory building extension around St Leonards, Lane Cove and north of Manly, where the rapid spread of residential suburbs has again created a labour pool, mostly females from middle-class homes, who would not be enticed to work in the unsightly inner zone. Again the industries appearing here are mainly light types such as clothing and household electrical equipment factories.

4. The satellite areas. Three of these areas exist at St Mary's, Villawood and Liverpool. The first two were developed as wartime industrial centres, but have now been transferred to general peacetime factory types. At present they are being expanded as part of the County of Cumberland replanning scheme for decentralising industrial centres. St Mary's, in particular, is being planned as a model type of satellite town, with the industrial units suitably located in relation to the residential sections, public services and amenities.

Figure 37 shows the complex nature of the water supply system of Sydney. Careful attention should be given to the symbols which are used in the key to the map, as well as to the scale.

The following facts are to be noted concerning the collection of water:

1. There are three catchment areas which lie south and south-west of the city, the Upper Nepean, Woronora and Warragamba.

2. The first two with areas of some 347 and 29 square miles respectively are fully developed and have in all five large dams, the Nepean, which holds 17,898 million gallons, Avon (47,153m.), Cordeaux (20,597m.), Cataract (20,743m.) and Woronora (15,792m.).

3. The Warragamba catchment area (3,383 sq. miles) supplies water by pumping from a pool formed by a weir on the Warragamba River, a tributary of the Nepean.

4. The map indicates that a very large dam is at present under construction on the Warragamba River. It will have a height of 360 feet and will store about 455,000 million gallons, which is greater than that impounded by the present Hume weir.

5. When water is required from the four dams of the Upper Nepean catchment area, it is first delivered into the natural stream courses below the storage. But at a later stage (as Figure 37 shows clearly) it is diverted from the rivers to flow for some 40 miles through tunnels, pipe aqueducts and open channels to the Prospect reservoir.

6. On the other hand, the supplies from Warragamba weir reach Prospect after travelling about 40 miles through a 4-foot pipe line. It will be noted that at one stage this line actually crosses the Nepean River itself.

7. Woronora dam supplies a series of reservoirs through a similar pipe line to that mentioned above, covering a distance of 16 miles. It will be observed that it maintains supplies for areas about the Sutherland district and over the George's River.

Distribution of water. 1. Prospect reservior is the final collecting point for supplies from Warragamba and the Upper Nepean catchments. From it the water is taken about five miles through a 6-foot pipe and a canal to a point near Guildford known as Pipe Head. As no treatment has been applied up to this stage, beyond the chlorination of Warragamba water to guard against hostile bacteria, supplies are screened to remove stray debris which may still be carried.

2. At Pipe Head comes the operation of diverting the water through large mains to the two major pumping stations of the city, Pott's Hill, which supplies the southern suburbs, and Ryde, which caters for the northern suburbs, by raising the water to sufficiently high levels. The higher sections, e.g. Dural and Cowan Creek, have to be assisted by supplementary pumping.

3. The chief metropolitan pumping stations within the southern built-up areas are at Waterloo and Crown Street, the water coming to them in the first instance by a 10-mile-long underground tunnel from Pott's Hill. Their work is to supply a series of service reservoirs from which a complicated pattern of suburban mains is fed.

Other features of the supply of water to the Sydney region are:

(*a*) service to the central South Coast from the Cordeaux dam;

(b) supplying of Camden, Liverpool and adjacent outlying parts by connections from the channel of the Upper Nepean dams;

(*c*) Richmond and Windsor townships using water direct from the Hawkesbury after treatment;

(*d*) general purity of the water as a whole, coming as it does from practically uninhabited catchment areas and being constantly checked by a rigid system of sampling and inspection.

(*e*) the tremendous demands made upon the present storage capacity of the dams, (i.e. about 125 million gallons daily) by the increase in housing and industry in recent years. It is hoped to meet this with the new dam at Warragamba which will increase storage by about 3½ times. In the mean time a vigorous campaign is being made to urge economy and prevent waste of water, and the controlling authority, the Metropolitan Water, Sewerage and Drainage Board, has avoided crises by this measure.

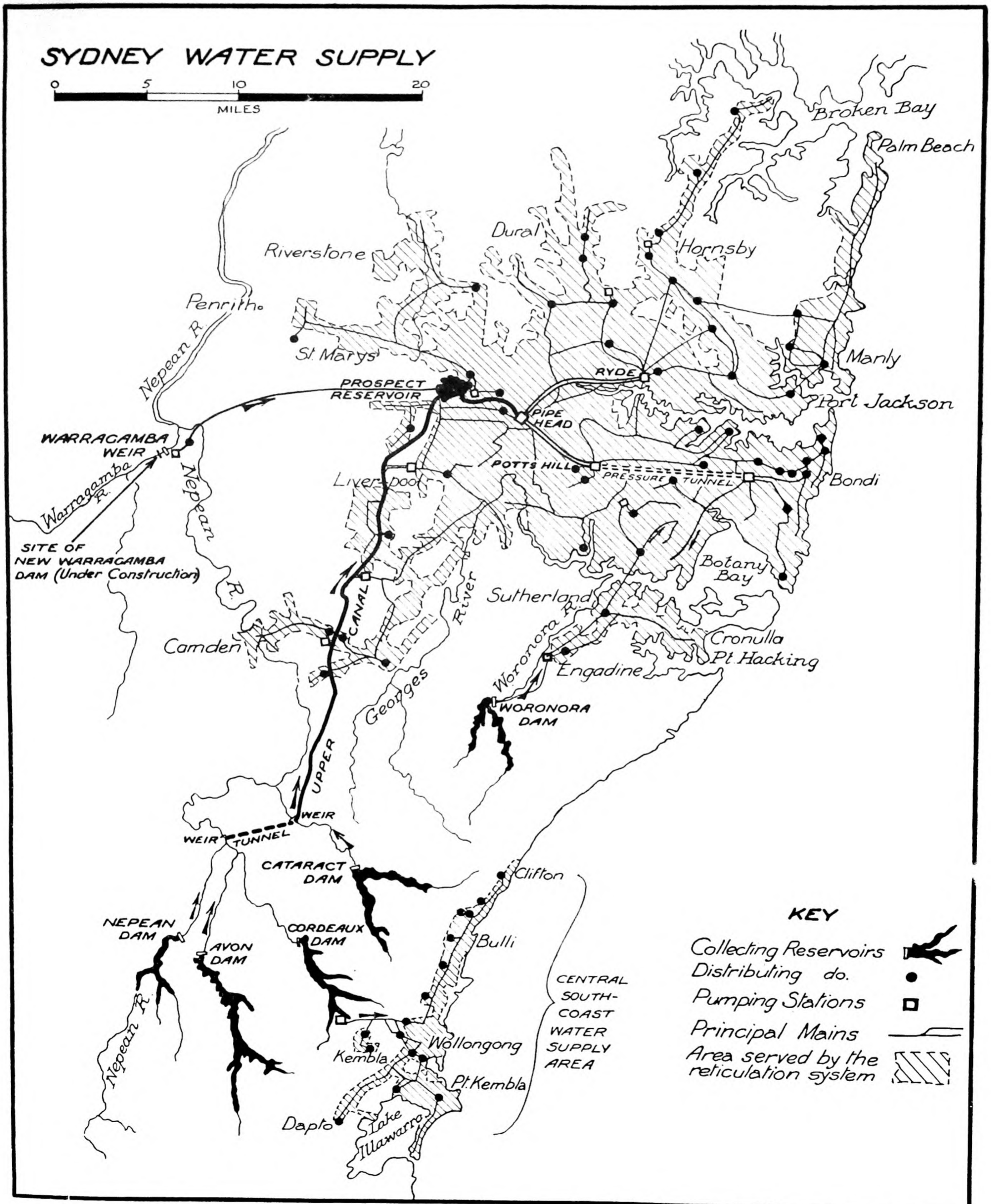


FIG. 37: Sydney area: water supply.

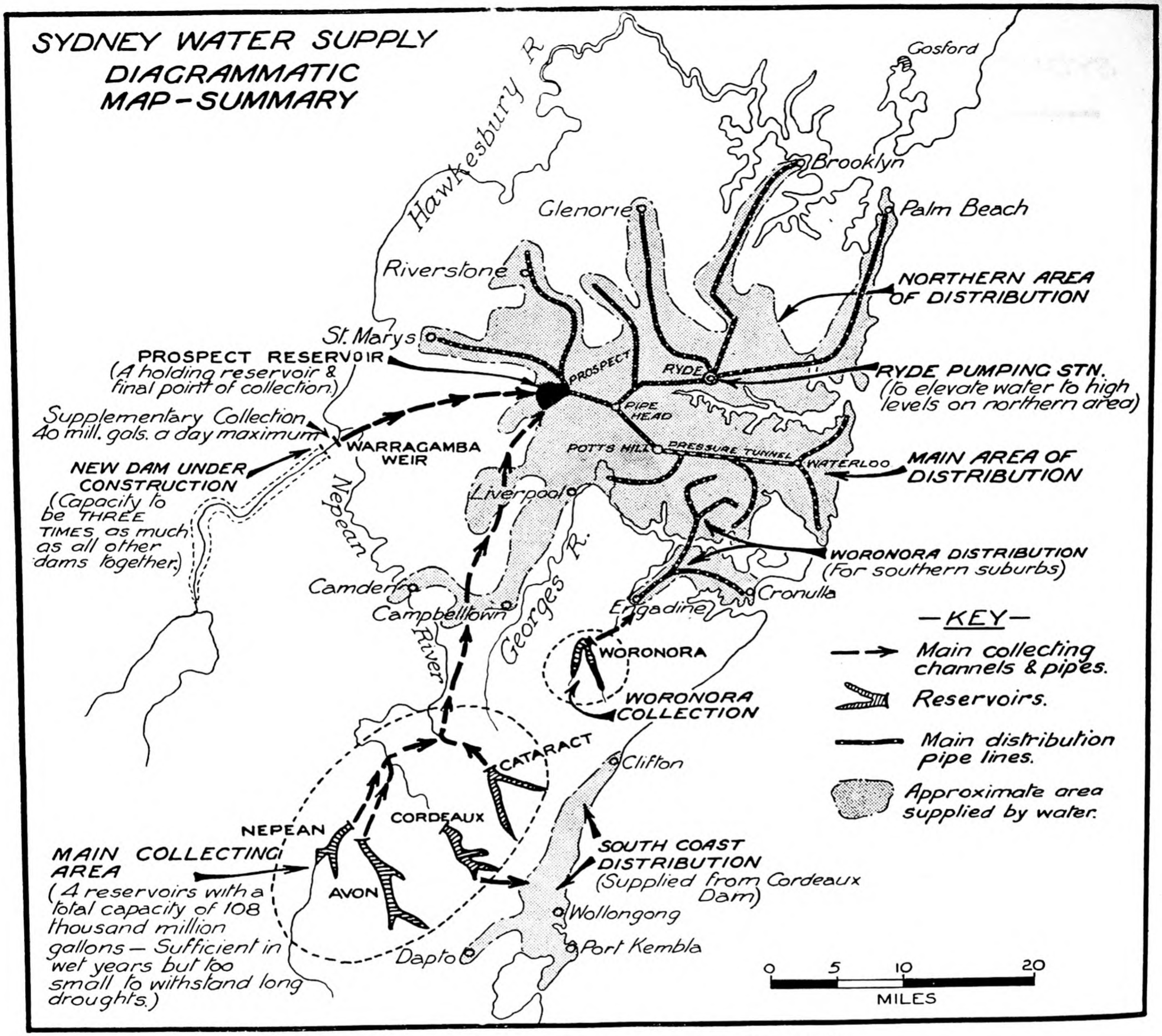


FIG. 38: Sydney: diagrammatic map-summary of water supply.

Diagrammatic map summary. Figure 38 represents a more diagrammatic approach to those geographical features which are generally characteristic of most large modern cities. It illustrates:

1. The initial collection of the water from the catchment areas by means of dams and weirs located in the narrow rocky valleys of uninhabited mountain, plateau or elevated land. As examples, the Upper Nepean here shown should be compared with the Catskills region which is important for the New York supply.

2. The need for holding reservoirs to which the water is brought from the many dams by open channels and/or pipes. At or near these final collection points it is usually necessary to set up plants to treat the water both chemically and by screening before passing it on to the major pumping stations. In this connection, the Staines reservoir outside London can be noted as comparable to Sydney's Prospect reservoir and Pipe Head shown on this map (see Figure 50).

3. The first stages of distribution involve the use of large pumping stations and huge underground pressure tunnels and pipes. These plants may also have the task of lifting water supplies to higher pumping points in the city, e.g. Ryde station seen here.

4. The second stage of distribution occurs where smaller pumps are used to fill the many service reservoirs strategically situated in the various suburbs, so as to gain a flow by gravity to the network of mains.

5. The drawing off of water from the mains completes the supply of a large city. It includes such important services as those to industry and homes, market gardens, public open spaces, i.e. recreation grounds, parks and gardens, and the daily flushing of streets. As well there is the demand from an extensive sewerage and drainage system in all cities where rigid health controls are imposed.

This map should be studied in conjunction with the remainder of the series on Sydney because the water supply is significant in the development of many of its other patterns of human activity. At the same time it provides an interesting comparison with the water supplies of other great cities like New York and London.

Farming in the Sydney region. The two sketches of Figure 39 are closely related to the problem of providing foodstuffs for a large urban population of some $1\frac{3}{4}$ millions. It is a tremendous task requiring a smooth running organisation for the supply and marketing of commodities, especially where the demand is a daily one, e.g. milk. Many of these commodities, particularly the perishable types, are produced within the Sydney region itself. Before examining the maps which help to explain the geography of such local production, it is advisable, first of all, to note the following general features of Sydney's food supplies as a whole:

1. They are drawn from three main sources other than the immediate hinterland, viz. other parts of the State of New South Wales, other States of the Commonwealth and overseas countries.

2. In the case of areas within the State, it would be true that almost all Sydney's essential foods are drawn from widely differing sections. This applies particularly to wheat and flour, potatoes, fruits, meats, dairy products and some vegetables. These are produced in areas where climate-soil-topography are most favourable to each crop. Thus there is a tendency to specialise so that certain crops become associated with certain districts, e.g. Batlow, Orange and Armidale for apples; Maitland for onions; the Murrumbidgee Irrigation Area for oranges, peaches and carrots;

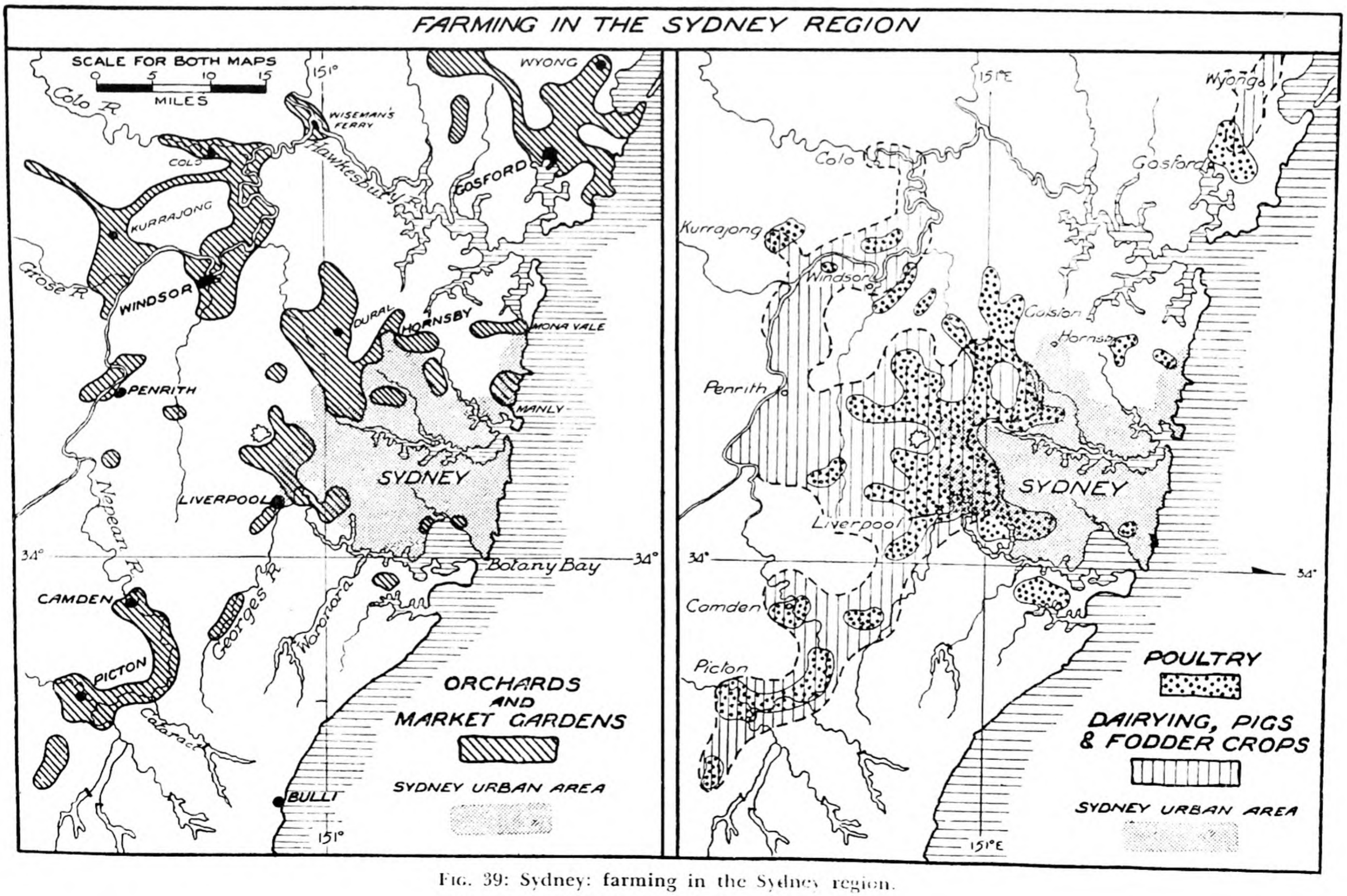


FIG. 39: Sydney: farming in the Sydney region.

Young for prunes; Orange for cherries and the North Coast for bananas, pineapples, and some sugar which is refined in Sydney.

3. Of the above mentioned products some are worthy of special note:

(*a*) *Wheat and flour.* These are drawn from the wheat belt of the western slopes and plains. The wheat is mostly sent to Sydney where it is made into flour in large mills. This enables the mills to make full use of the various by-products of the industry, e.g. pollard and bran, which are essential to the large poultry rearing group within the immediate Sydney plain.

(*b*) *Milk.* As noted in the work on dairying in New South Wales in the companion volume, *The Rural Scene,* Sydney draws the bulk of its 50 million gallons of milk a year from areas well beyond the city area. Actually only 15 per cent of the milk consumed is produced in Cumberland county. The distance the milk may be carried is usually governed by that covered in an overnight journey by the kind of transport used. With express train services this may be as far as 300 miles.

(*c*) *Butter and cheese.* These come from the dairying areas of the north and central coasts and the Illawarra district.

(*d*) *Meat.* This is drawn from all parts of the State to be slaughtered at the Homebush State Abattoirs. Important by-products from this plant include hides, offal and blood for manures, and hoofs and horns for gelatine and glue.

(*e*) *Vegetables and fruits.* When out of season in New South Wales these are often supplied from other States. There is also a large movement of certain types of fruits and vegetables from other parts of the country, where they grow better, to Sydney, where they are difficult to produce. Thus onions, potatoes, celery, peas and beans, sprouts, cabbages, tomatoes and cauliflowers are brought from Victoria, Tasmania, South Australia, Queensland and even Western Australia, when out of season or in short supply in Sydney. The high prices received more than compensate for the freight charges. Tropical fruits from Queensland and apples and pears from Tasmania are other examples of this movement.

Other important products from the rest of Australia include salt (South Australia) and sugar (Queensland). The latter is brought in an unrefined state and is processed at the Pyrmont refineries.

4. Food imports include those products which Australia does not grow or manufacture. These are, for example, beverages like tea, coffee and cocoa, and various condiments and spices. The movement of many foreigners to Australia has popularised such overseas foods as special types of tinned fish, biscuits, cheeses, wines and oils. These are usually high-priced delicacies and so the amounts demanded are small.

5. There are several other worth while aspects associated with the collection, marketing and distribution of foodstuffs in the Sydney region.

(*a*) There is a marked trend towards the use of canned goods, especially of vegetables and fruits from the Riverina and Bathurst areas. The reasons seem to lie in the ease of handling and the freshness of the goods, e.g. in some cases the fruits and/or vegetables are processed and tinned within four hours of picking.

(*b*) Refrigeration and cold stores are employed on a wide scale in order to preserve perishables and meet shortages. Railway rolling stock and ships are constantly being improved to permit better transport of chilled and deep frozen cargoes.

(*c*) Compared with other large cities which do produce some portion of their foods in the immediate vicinity, Sydney is fairly self-contained. By way of contrast, 70 per cent of London's food comes from overseas.

(*d*) The city's access to various types of transport assists very much in the collection of its foods, e.g. wheat by rail, vegetables by truck and sugar by ship. Fish are obtained by trawling between Port Macquarie and Bateman's Bay and are marketed through the fish markets in the Sussex Street area. Shellfish come mainly from the Hawkesbury and Tuggerah Lakes region.

(*e*) Air transport is increasingly used in the movement of perishables, especially vegetables when in short supply.

(*f*) Marketing is confined almost to one section of the city core as illustrated in Figure 35. Near by are the wholesale grocery merchants who handle local and overseas lines.

In a survey of the maps showing the areas of actual farming in the Sydney region, the general points to note are:

1. The need to compare these from time to time with the rest of the Sydney series, more particularly those showing the patterns of the landforms, settlement and transport. The student is referred to the chapters on specialised farming in *The Rural Scene,* where irrigation and market gardening in this region are discussed in some detail.

2. The spread of the urban area in relation to the over-all agricultural occupance of the plain and uplands. A little farming is still carried on within the built-up section.

3. Sections of the region are still not utilised, like the more rugged and infertile uplands north of Hornsby and south of Port Hacking.

4. The location of the various satellite towns both in relation to their own immediate agricultural areas

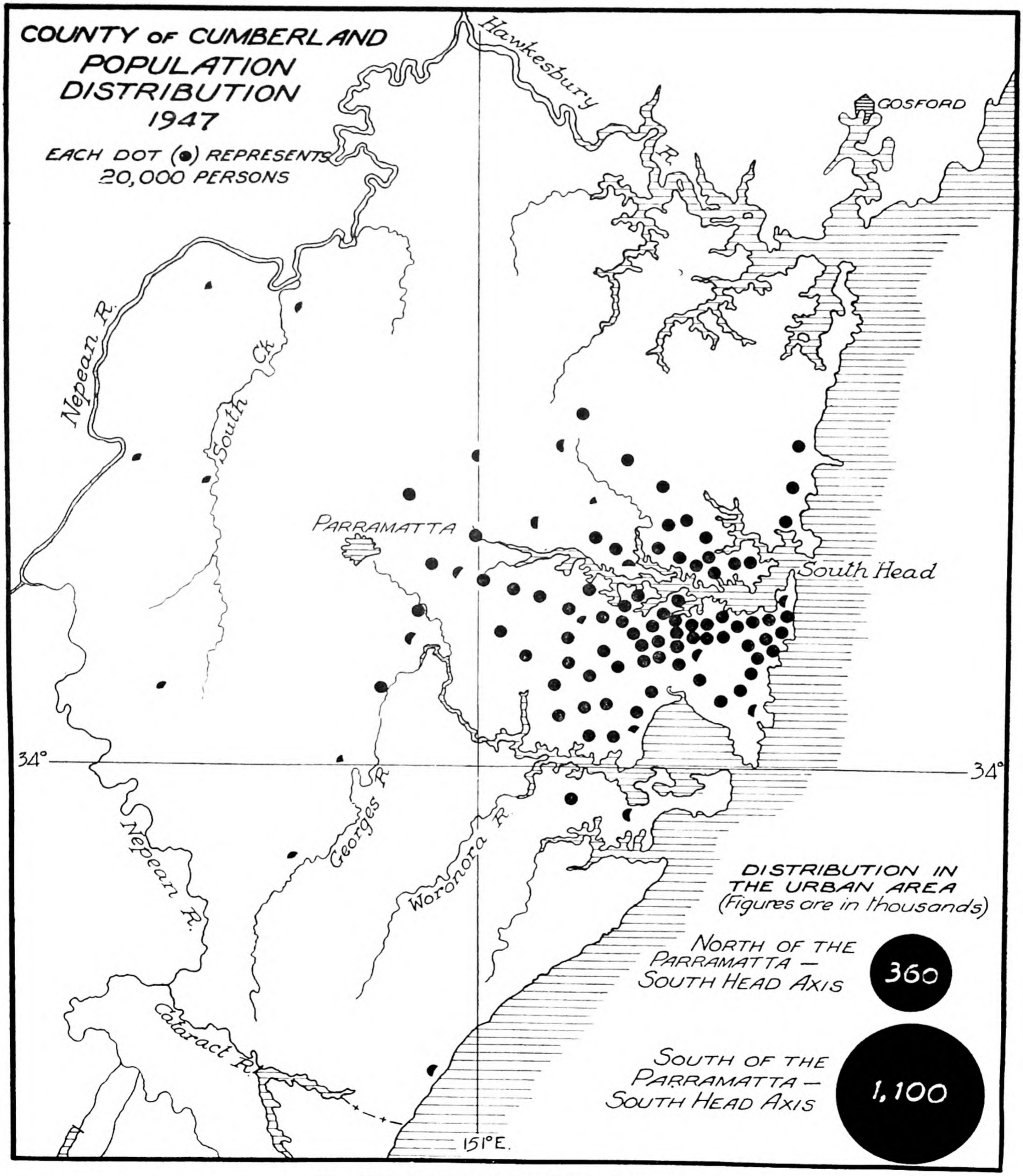


FIG. 40: Sydney: population distribution.

and the more distant city. Many of these began as market towns in the early settlement of the plain, e.g. Richmond and Windsor. Today these are largely by-passed as market centres because of the short truck haulage to the main Sydney markets, but they may be collecting points still for certain products, e.g. milk.

5. Sydney is the *entrepôt* for the dispersal of the products of the region which in relation to the State as a whole grows approximately the following amounts: poultry (70 per cent); milk (15 per cent); citrus fruits (18 per cent); vegetables (17 per cent); grapes (14.5 per cent); non-citrus fruit (7 per cent).

Analysis of the maps shows that there are roughly two subdivisions, an inner zone, and an outer zone.

1. The inner zone. This is within the near-city area and is known as the rural-urban fringe. It embraces Newport-Manly; Hornsby-Galston-Dundas; Blacktown-Prospect; Liverpool-Bankstown; and Botany-Mascot districts. Features are

(*a*) Crops here are grown on small (6- to 12-acre) farms by intensive methods, using much manure, irrigation (spray method generally) and manual labour to produce two or three crops a year. These include tomatoes (often in hot houses), lettuce, celery, carrots, parsnips, turnips, melons, beet and some citrus and stone fruits.

(*b*) Poultry farming for eggs is important in all the sections, and is confined mainly to the less fertile land. The industry leans heavily on the adjacent supplies of food from the flour mills.

(*c*) This is a zone which contributes entirely to the day-to-day needs of the urban population. The main stimulus is the adjacent urban market, where there is a ready sale and a keen demand for the commodities produced.

(*d*) Transport charges are low, with the farmer often taking his produce direct to the markets. This offsets the high cost of land improvement on the generally infertile soils of the areas, and the costly manuring, irrigation and hand labour required to grow crops.

2. The outer zone. This extends to the Gosford district and from there to Kurrajong and the Hawkesbury-Nepean valley floors, where

(*a*) The farms vary in size from 40 to over 300 acres, and the growth of fruit and vegetables is carried on in parts of the farm only. These are usually the more fertile river flats or the hillsides with suitable soils and aspects.

(*b*) Much of the land is devoted to dairying and the growth of fodder crops, while large portions of many farms are used for grazing only after the natural forest cover has been thinned out or removed.

(*c*) This zone, therefore, shows features intermediate between the intensive market-gardening of the rural-urban fringe, where economic factors are the prime determinants of farming character, and the extensive farming areas of the tablelands and western slopes, where physical suitability (climate-topography-soils) is the major factor determining the crop types and the farming pattern.

Sydney region—Distribution of population, 1947. Studied in conjunction with the other maps of the Sydney series Figures 40 and 41 reveal a number of geographical features as determinants in the pattern of population spread. These are:

1. The general high density of the southern side of the Harbour as contrasted with the north.

2. The series of "shoestring patterns" on the north side due in the main to:

(*a*) the ridge-like character of the plateau uplands, with the major highways strung out along them, e.g. to Hornsby;

(*b*) the peninsula character of the Mosman-Cremorne-Middle Harbour area;

(*c*) the coastal limitations north from Manly.

3. The most rugged sections (largely the national parks and catchment areas) which are unsettled.

4. The sparsity of population in the rural-urban fringe, more especially in the western parts.

5. The largest agglomerations in the western section of the plain are those of the former market towns Richmond, Windsor, Penrith, Liverpool, Camden.

6. The density along the southern shores of the harbour, resulting from occupance by port facilities, wholesale and retail stores, private and public finance and administration, and industrial activities.

7. Associated with these are densely settled residential sections of the eastern and western suburbs from which there is a marked fanning out by ribbon development towards Parramatta, Bankstown, Sutherland and Botany. Heavy industry is linked with some of these.

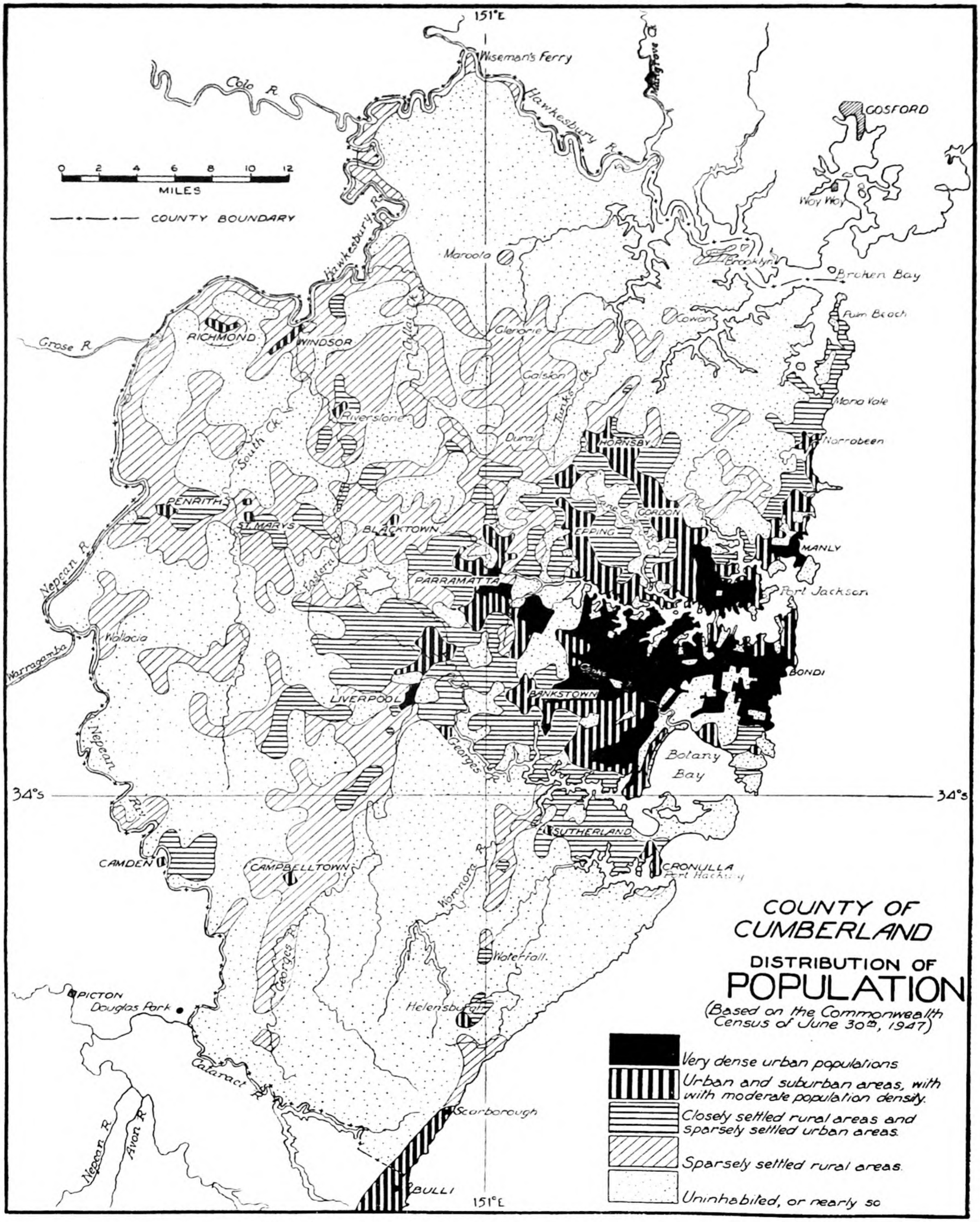


FIG. 41: Sydney: density distribution of population.

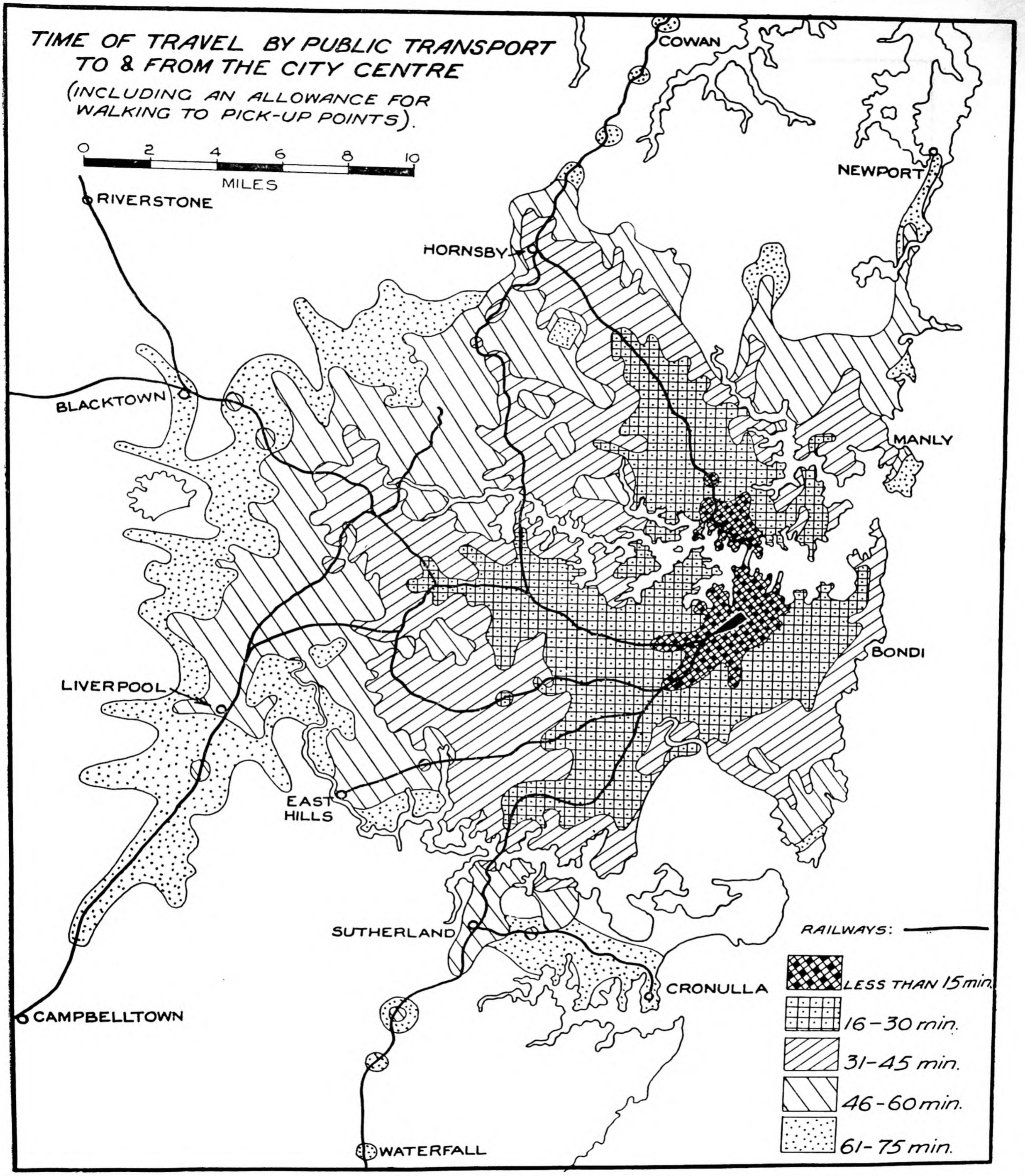


FIG. 42: Sydney: travelling time by public transports. *(After Cumberland County Council)*

Travelling time: Sydney

Time of travel by public transport to and from the city centre. A full appreciation of Figure 42 can be had when it is studied together with that of the population pattern and density (see Figure 40), since transport is very important in determining where people will live in terms of time taken to reach work and the shopping centre of the city from home, and vice-versa. Some of the important factors bearing on this time of travel pattern are:

1. The speedy electric railway transport which brings centres like Lidcombe (nearly ten miles from the city centre) closer in time than Bondi (barely four miles away), which depends on bus and tram.

2. Rugged topography and lack of good fast transport create areas of extended travel in suburbs relatively close to the city, e.g. north of Middle Harbour and Lane Cove.

3. Although not shown here, the congestion within the city core causes fairly slow travel there: many routes can be seen to concentrate on it, e.g. Central Railway.

Some of the features incidental to this map are concerned with the fact that large numbers of people travel through the city to their places of employment: this adds considerably to their travelling time each day. Even this may be speeded up when omnibuses are substituted for trams in some suburbs, and the eastern suburbs electric railway is completed.

On the whole Sydney's problems of transport are tremendous and increasing. A partial solution lies in the development of more satellite towns with decentralised residential and industrial areas, and a series of radial highways to prevent a maximum concentration of traffic within the city core, either in terms of parking, internal movement or movement through it. It is along such lines that the future planning of the Cumberland County Council is proceeding, and if implemented it should have most interesting effects upon Sydney's urban geography.

9

NEW YORK

The position of New York (Figure 43). In order to understand the city geography of New York, it is first necessary to note certain general but important geographical and historical factors which helped to determine its precise position and phenomenal growth.

The geographical factors. 1. The actual city port occupies an area of some 322 square miles at the tidal mouth of the Hudson River estuary. As the locality map (Figure 44) shows, much of it stands on a series of islands, Manhattan Island, Long Island, and Staten Island. Manhattan Island is cut off from the mainland by the Hudson and East rivers.

2. New York possesses a magnificent protected harbour. As Figure 45 shows, Upper and Lower Bays separated by the Narrows, a mile-wide channel. Strong tides sweep into the harbour each day, and it is sufficiently far south never to be ice-bound like the St Lawrence waterway to the north.

3. The Hudson River valley is an important waterway because:

(*a*) Its lower course is a drowned glacial valley, and actually a narrow arm of the sea.

(*b*) In its upper course the long narrow passage of the Mohawk tributary, the Mohawk Gap, forms the only complete low-level break across the Allegheny and Adirondack Mountains. This fact is important since these uplands, running roughly parallel to the coast, form a barrier between the coastal plain and the wealthy hinterland of the Great Lakes, Pennsylvania and the middle west (see Figure 16). This should be compared with Sydney's position in relation to its hinterland.

(*c*) The Hudson River rises in the Adirondack Mountains close to yet another gap between them and the Green Mountains. This north-south break is that of the Lake Champlain valley. As the map indicates it links up with the very important St Lawrence River system at Montreal.

4. In addition to the above there are immediate regional aspects of

(*a*) the mountain hinterland region providing water supply, hydro-electricity and recreation areas for the city, e.g. the Catskill Mountains;

(*b*) the coastal plain to the north and south of the estuary, permitting, in spite of relatively poor soils, an intensive development of truck farming, dairy farming, and orcharding for city food supplies, especially noticeable in New Jersey and Delaware;

(*c*) the basaltic rock character of Manhattan Island itself, permitting the building of great numbers of huge buildings, tunnels and bridges, and corresponding to Sydney's sandstone;

(*d*) numerous other tide water ports nearby providing shipping facilities and valuable fishing areas, e.g. Chesapeake Bay and Boston.

5. New York also possesses a strategic position in relation to Europe, the British Isles, and Mediterranean ports. As will be seen later (see page 73) this was an important factor in the settlement, growth and trade of the city.

6. On the whole the climatic conditions of the New York region are favourable to the settlement and vigorous activities of European peoples. The mean annual temperature is 52°F. In July and August, the two hottest summer months, the mean daily temperature reaches a maximum of 83°F. while in February, the coldest month, the mean daily temperature sinks to a mimimum of 28°F. The highest recorded temperature is 102°F. and the lowest 14°F. below zero. The annual rainfall amounts to about 43 inches. This large seasonal range of temperatures shows the climate to be invigorating.

Historical factors. 1. The Dutch settlers first established a trading post on Manhattan Island in 1625 because it was the outlet for an inland route and had a good natural harbour.

2. When the British acquired the area by about 1664, the population numbered only 1,000 and was hemmed in by mountains. Penetration to the interior was hindered by the French, who constructed forts to block the Champlain, Mohawk and Susquehanna outlets. The growth of the port of New York was therefore slower than that of Boston, Charleston and Savannah until the Seven Years War removed the French stranglehold. Even in 1790 New York had but 33,000 inhabitants.

3. This position was completely altered and New York came into its own as a port and trading centre when the Erie-Mohawk Canal was opened in 1825. Prior to this the immigrant stream entered mainly through the ports of Boston, Baltimore and Philadelphia, and because of hostile Indians in the virtually unknown Mohawk valley, had moved over the mountains to the west by various trails to settle on the fertile interior plains of the Ohio River (see Figure 16). These settlers subseqently found that the transport charges on their farm produce of wheat,

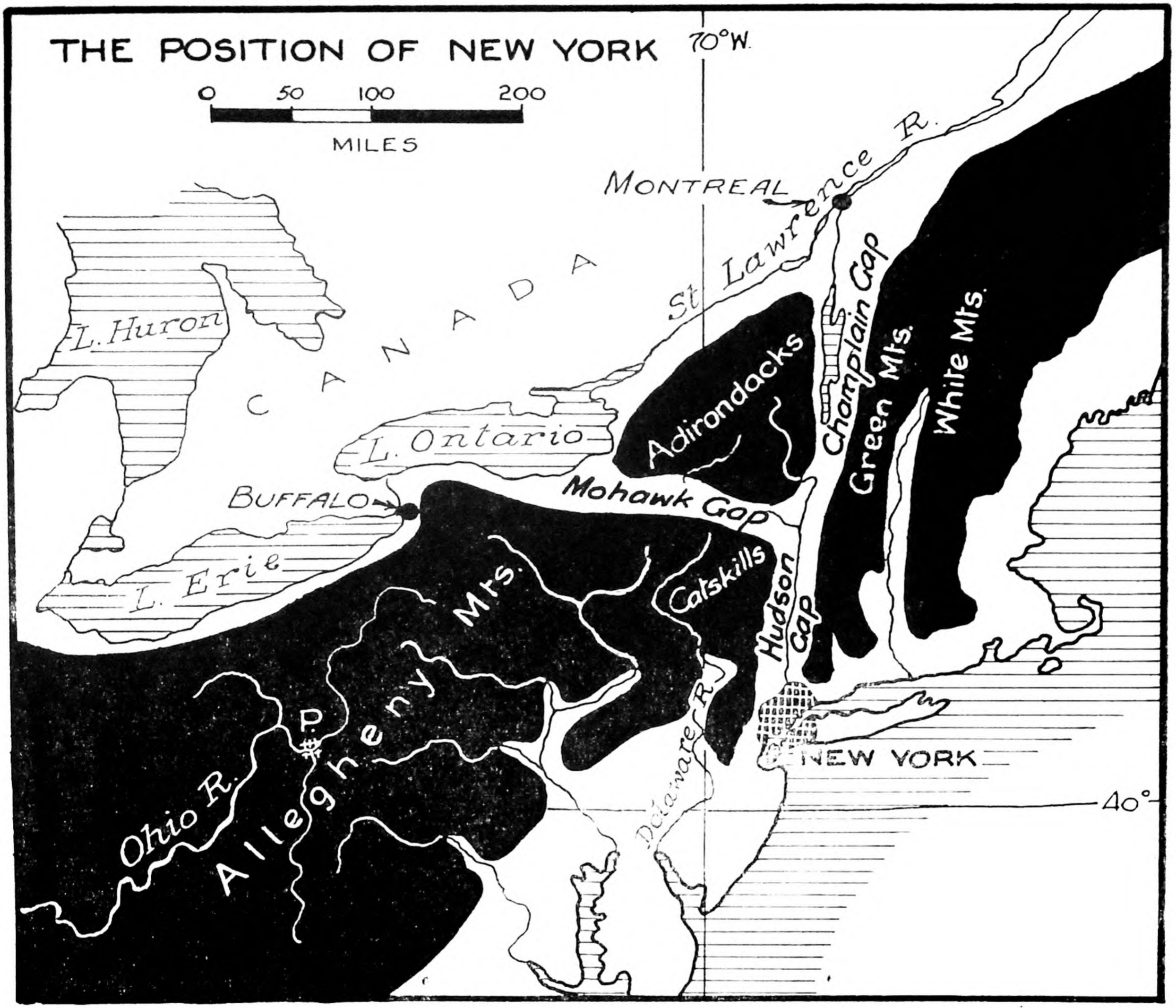


FIG. 43: New York: position.

corn and meat, were so high, when sent along these land routes to the coastal settlements, that little was left for the farmers' profit. So it was decided to make greater use of the only real break in the highland barrier and to provide cheaper transport in so doing. For that reason the Erie-Mohawk Canal was built in 1825. Another canal was constructed to connect the Hudson with the St Lawrence *via* Lake Champlain. The over-all result of the development of this cheap and direct transport is shown in the great growth of New York between 1820 and 1860, when the population reached 1,175,000. Thus New York became in a short time the door to a vast and extremely wealthy hinterland.

4. In the next 50 years or so New York's importance grew in an amazing manner because of the interaction of several factors, some geographical and some historical:

(*a*) Unrestricted immigration from Europe, for which New York was the principal port of entry.

(*b*) A large number of these immigrants were former city-dwelling Europeans who tended to remain in New York, where they set up small manufacturing and trading establishments, and generally grouped into "foreign village" communities. This mixture of new peoples contributed much to the talent, vigour and vitality of the city's industrial, commercial and cultural life.

(c) Tremendous expansion of agricultural and industrial activities in the Middle West helped to maintain the importance of New York, as it has been, since 1825, the main outlet of this region.

(*d*) The construction of rail and road networks focusing on New York greatly aided its growth, e.g. today the Mohawk Gap carries one canal, two arterial roads and six railway tracks.

(*e*) The growth of manufacturing within the city itself. Today there are over 30,000 factories within the city limits making consumer goods for local consumption and for the large markets within the States, as well as for overseas.

(*f*) The creation of Greater New York in 1895 meant the inclusion of several nearby densely settled areas such as Brooklyn, Bronx and Queens.

(*g*) The reclamation of land for building purpose and the construction of many "penthouses" and skyscrapers. This allowed greater concentration of people for both living and working.

(*h*) The building of the largest airport in the world at Idlewild in recent years has given one more factor to aid in the growth of the city population.

(*i*) The large tourist traffic to the city, an estimated five millions a year in normal years, maintains a great number of people catering for their wants, and gives the city much of its special amusement and night-life character.

Thus New York owes its pre-eminence not only to geographical inertia factors of landforms, climate and waterways, but to certain significant historical and sociological circumstances. Above all, its admirable location for commerce and transport have earned it the definition of "a giant product of transportation". This is so because nowhere in the world is there such a supreme focus of routes by land, sea and air.

Locality map of the New York city area. Figure 44 is concerned mainly with the major political and geographical areas which have developed as a result of New York's many functions.

New York city itself is situated in the south-east corner of the State of New York (one of the States of the Union), the boundary of which runs down the middle of the Hudson River and the Killvankull (the narrow strait between Staten Island and the mainland) into the Lower Bay. This divides the built-up city area into two political units, one in New York State and the other in New Jersey State. In other words there is a distinction between a political urban area and a geographical urban area. Subsequent discussion will be concerned with the full geographical area of New York rather than the political.

A further administrative division is that of the boroughs, of which New York city proper has five. These are:

1. Manhattan. This is the original New York city situated on an island some 13 miles long and about two miles wide. In addition there are several other islands, e.g. the small Welfare, Ward's, Governor's and Randall's, with a total area of 22 square miles. The smaller islands comprise military installations, city hospitals and other institutions, Manhattan is the city core, more especially Lower Manhattan, with its major interests in finance, trading administration and organisation of city social services. A tremendous commuter traffic reaches here daily by rail, road and ferry. This section of the city compares with Sydney's inner areas, except that New York does not possess the offices of State government; these are situated in Albany.

2. Bronx. This comprises the mainland north of Manhattan Island and has a total area of 42 square miles. It is largely middle-class residential but also has industrial and commercial activities.

3. Queens. This contains a portion of Long Island, which includes Rockaway Beach and numerous small islands in Jamaica Bay. Here the area of 121 square miles is taken up mainly with middle- and upper-class homes although there is an industrial and commercial section along the East River.

4. Brooklyn. This is made up of portion of Long Island and Coney Island, and a number of islands in Jamaica Bay, comprising in all an area of 81 square miles. There are large localities devoted to commercial and industrial plants, as well as a middle-class residential district.

5. Richmond. Otherwise known as Staten Island, its 57 square miles are essentially middle- and upper-class residential areas with considerable open space devoted to parklands.

Referring again to the map it will be noted that the geographical urban area as distinct from the administrative, embraces also a series of important centres west of the Hudson River. Their location is indicated by numbers or large lettering, and for purposes of description may be zoned approximately in the following manner:

1. The riverside centres. Jersey City (550,000) is a railway terminus with enormous yards, a coal shipping port and exporting centre for agricultural produce and iron manufactures. It also makes machinery, canned meats, iron and steel goods, chemicals, pottery and tobacco products. Bayonne (200,000) an oil pipe line terminus with the world's largest refineries, Hoboken (60,000) is a shipping centre for coal. The above three industrial localities, strung out as they are along the river, compare with the harbour-side activities of the port of Sydney.

2. The inner industrial cities. Newark (600,000) is an educational centre which also manufactures chemicals, machine shop products, foundry goods, leather

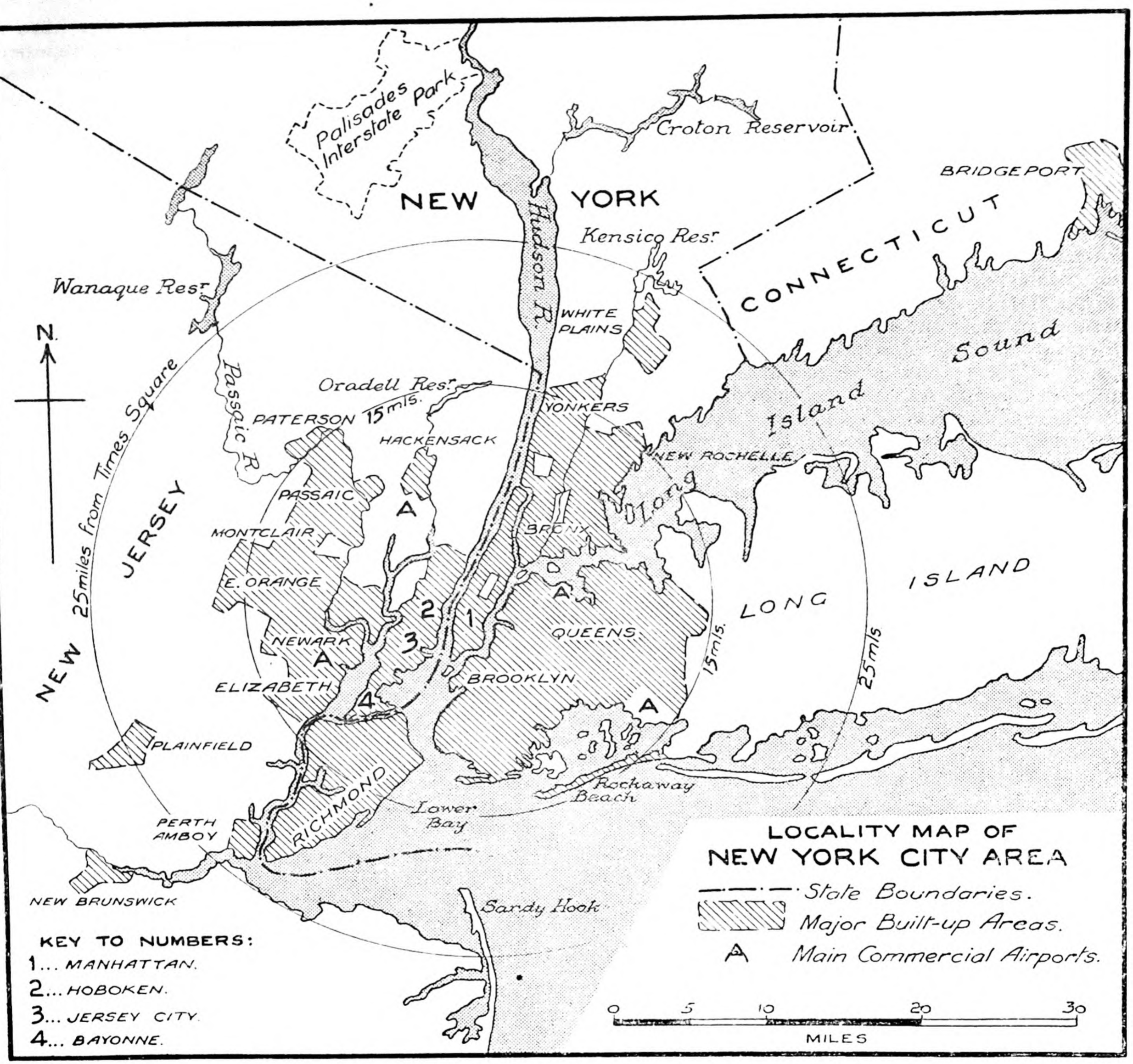


FIG. 44: New York: locality map.

and machinery. Elizabeth (200,000) is the home of the famous Princeton University. As a manufacturing centre it produces the Singer sewing machine, and has oil refineries and railway workshops.

A comparison with Sydney would place these two centres about the locality of the Homebush-Lidcombe industrial area.

3. **Outer industrial cities.** Paterson (150,000) is a centre of rayon manufacture in U.S.A. Passaic (120,000) has metal smelters (copper, lead and steel) and manufactures of textiles and chemicals.

Compared with Sydney's localisation of industry these centres could be paralleled with St Mary's as related to the city core.

4. **Outer residential cities.** Although these have their own local industries they are predominantly residential in character, and in point of distance from the heart of the New York city proper would

be something like the upper north shore in relation to Sydney's core. The main centres are Orange (60,000) which turns out electrical goods and hats. East Orange (100,000) manufacturing electrical apparatus and pharmaceutical supplies. Montclair (70,000) a summer resort making paper goods.

In a brief review of the above, attention is drawn to the two circles placed on the map and centred (by a black dot) on Times Square of Manhattan. That circle, with a radius of 15 miles, takes in almost all the built-up sections named and is roughly comparable to the corresponding part of Sydney in its areal spread. The outer limits are but little further from Manhattan than Hornsby, Liverpool or Parramatta are from the centre of Sydney. In addition, the population of these areas as shaded on the map, plus numerous peripheral ones not indicated within the 25 miles radius circle, is no less than 14 millions. As such they represent the largest urban agglomeration of population in the world.

From all this it is easy to understand, too, that those centres west of the Hudson are linked with the centre of New York by commercial and industrial ties in exactly the same manner as Brooklyn and the Bronx, and that to all intents and purposes the physical and political water boundary of the river does not affect the actual geographical unity of the urban area as such. As will be seen later this is reflected in the enormous daily traffic in people, goods and vehicles moving from the east and west to centre on Manhattan and produce there that amazing pattern of functional activities reserved for the next map (Figure 45).

The activity pattern of New York. In studying Figure 45 attention is drawn in the first instance to the general pattern of zoning discussed in the introductory remarks to the geography of cities (see Figure 30) and already seen to apply to the lay-out of London and Sydney. Secondly, a note can be taken of the inclusion of the political boundary line; but as already pointed out this is not especially significant in examining the geographical urban area of New York.

With respect to details of the activity pattern sketched in Figure 45, the main points are:

The financial core. Situated at the southern extremity of Manhattan, this is the centre of operations (banking, stock exchange, insurance, shipping, etc.) for almost all the powerful financial concerns of U.S.A., e.g. oil, steel and cars whose actual manufacturing operations are carried on elsewhere, as well as for many overseas firms, and is one of the great trading places of the world. The site is very restricted, occupying as it does the original area of the early settlements, with the famous Wall Street being the boundary marked by log defences against Indian attacks. Over the years the land became increasingly valuable with its strategic port site, so that when a building boom occurred in the 1900s there appeared here the characteristic New York skyscrapers. These are literally vertical streets and in recent years have reached fantastic proportions here and elsewhere in the city, in number, size and function. The result today is a series of towering buildings with narrow canyon-like streets. In spite of many great differences this section of the urban area is similar in its operations to the core of Sydney.

Commercial centres. It will be observed that these are not only confined to Manhattan Island but are spread around, and inland from, adjacent foreshores to a series of centres already mentioned in the work on the locality of New York and its environs. For purposes of organisation of material a rough zoning is as follows:

1. Manhattan. The commercial areas here occupy a fair proportion of the island, being found both along the broad north-south avenues like Broadway as well as the narrow short cross-streets. Thus there are:

(*a*) The administrative headquarters of many firms who naturally are desirous of proximity to the financial core; included in this section is another series of skyscrapers like those of the Rockfeller Centre and Radio City.

(*b*) The wholesale trading centre handling such important commodities as produce and cotton textiles. These have large warehouses and are in close contact with the major bulk transport lines of ship and rail as well as roads both under and over the Hudson River tunnel exits and the huge railway terminal of Pennsylvania station are in this area.

(*c*) The retail centre, south of Central Park, with a wide range of commercial activities, more especially in clothing, motor cars and publishing. Within this section there are several huge department stores like Macey's and Gimbel's. Here, too, there is the famous entertainment section, near and north of Times Square, abounding in theatres, hotels, motion-picture houses, night clubs and restaurants. Then there is the best-known shopping centre of New York along Fifth Avenue, with luxurious style and specialty firms nearby Madison Avenue. East of these two trading localities is Park Avenue, once the most fashionable residential district, with the homes of the business magnates.

2. Brooklyn, Queens, Jersey City, Bayonne, Hoboken and Union City. These all have a close connection with the handling and processing of raw materials, arising in the main from their situation on the harbour foreshores. They are generally represented by large warehouses and blocks of administrative offices as well as scores of shops, hotels, apartment houses and restaurants catering for the local population.

3. Satellite cities. Reference has already been made to the series of satellite settlements stretching out from the above and characterised by much the same type of commercial pattern, but with greater areas of residential occupance. These include such centres as Elizabeth, Newark, Passaic, Yonkers, Fordham, Melrose, Westchester, Flushing, Jamaica and Flatbush.

Industrial areas. Although these are shown as two sections on the key to the map, we treat them as one, with such emphasis as will be needed from time to time to show any marked differences. Thus:

1. In the case of areas west of the Hudson most of the satellite cities, e.g. Newark with large residential populations, are associated with a wide range of local light industries.

2. These are characteristic of New York manufactures as a whole because—unlike Pittsburgh for example—the competition for very limited land space, and the immediate needs of a huge urban population make heavy industries impossible.

3. On the other hand there is a concentration on the production and/or processing of such items as clothing, foods and beverages, and housing materials, including interior fittings, furniture and utensils for the market within the city.

4. At the same time a good number of the 30,000 factories here are engaged in the production of ready-made clothes and accessories, fur goods and jewellery, for New York is the nation's centre for these and one of the fashion leaders of the world. These are for dispersal throughout the entire country along with such other things as books and magazines, soap, tobacco, metal goods, chemicals and glassware.

5. The larger industrial localities include:

(*a*) *Manhattan.* Within the districts shown on the map there are miscellaneous industries, each tending to have its own special localisation due to various factors. Noteworthy examples of these are those connected with the food trade (especially fish, meat and general produce) and leather goods close to the source of supplies along the harbour front. Publishing and light machinery are located in the vicinity of cultural activities and motor car display and sales centres. By far the most extensive and important industry here is that of the clothing trade, which got its original impetus back in the eighteenth century when New York became the wholesale market for the imported style goods and materials from Europe. As the local manufacturers began to rival these they also established themselves in or near the warehouses, so that in time whole buildings became the centres for the making, display, storage and sale of garments. Added to this, great numbers of immigrants subsequently provided a source of cheap labour and lived under shocking conditions close to their work until the trade was organised into one of the most powerful unions in the country. Today there are about 7,000 garment plants, providing not only for the needs of the immediate New York population, but for about three-quarters of the nation's women's clothes and one-third of the men's. Most of this work is done virtually in the heart of the city to the south of the Central Park commercial centre.

(*b*) *Brooklyn and Queens.* Although over a million people move daily from their residences on Long Island to work in Manhattan, many others are occupied in the local industries of Brooklyn and Queens. Both are interested in many similar trades, e.g. clothes, baked foods (biscuits), paints and varnishes, furniture, toys, metals and precision instruments, yet they have certain individual characteristics. For example, Brooklyn has a waterfront of over 100 miles, along which many large warehouses are concerned purely with the handling and storage of goods in transit, for almost one-sixth of the overseas and coastal trade of the harbour centres here. Along with this storage, factories are found, making many of the products listed above, including some of the largest makers of printing and rolling machinery, clothes, shoes and pharmacy chemicals. Also there are many activities associated with the navy shipyards, firms specialising among other things, in nautical and aviation instruments. Close by are America's largest mercantile ship repair yards.

Geographically, manufacturing in Queens is far more concentrated than in Brooklyn. Over two-thirds of all goods produced by Queens are made in Long Island city which is adjacent to Newtown Creek and a main bridge from Manhattan. The presence of these and the added fact that great railway yards cut diagonally across Long Island city give this community a strategic location. Raw materials can be lightered up from New Jersey, finished products can be shipped out by rail or truck into Manhattan, up to New England, or to the north. As a result there is a welter of factories, the major ones being concerned with the refining of sugar and the making of chewing-gum, biscuits, toys, pianos and commercial printing.

(*c*) *Bronx and Yonkers.* These are representative of industrial areas in the northern portion of the city. Yonkers, which is some 14 miles from the centre of the urban area, has a frontage to the Hudson, and its manufacturers are specialists in the production of lifts or elevators. With New York possessing so many tall buildings about one-quarter of their business is concerned with them. In addition there are big rug and carpet mills, and close by cable and wire plants. Industry is restricted in the Bronx to the southern tip of the borough, and there are located builders of large printing presses and precision machinery.

Wharf and harbour-side industries. In addition to particular activities already described and the general physical geography affecting their form and function, we may note the following facts:

1. New York harbour is well sheltered by reason of its peculiar relation to the open sea, and its shape, inlets, islands and rivers. The entrance is relatively wide and straight, making for easy pilotage.

2. It has deep water (40-50 feet) in its channel and close to the shore and so can accommodate large ships. Tidal scour and currents help to maintain this, but some blasting and dredging are necessary from time to time, especially in the shallower waters of inlets like Newark Bay.

3. Because of the great expanse of negotiable protected water, there is also ample anchorage space for shipping.

4. As the tidal range is no more than five feet most ships can be handled at all stages of the tide.

5. As pointed out before there is freedom from ice, so that an open channel can be maintained at all times of the year. On the other hand, New York harbour does suffer the disability of dense fogs from time to time and these can hold up shipping and other activities indefinitely.

6. The shorelines are mostly below 250 feet in height (Richmond Island is about the highest, with 400 feet), and in spite of the limited area of Manhattan Island, there is considerable space elsewhere for the necessary construction of piers and wharves, warehouses, traffic lanes, industrial units, administrative offices and residential quarters.

If to these geographical features of the harbour there are added, (*a*) those already mentioned in connection with its strategic location to the hinterland; (*b*) the proximity (due to coastal configuration) of the four major ports of Philadelphia, Baltimore, Boston and Norfolk; (*c*) the historical factors which aided the pattern of settlement and development, it can be understood why New York is one of the world's great natural ports. Yet in order to appreciate its full significance in the field of modern trade and commerce, account must be taken of man's adaptation of this magnificent site. Thus:

1. Of the total water frontage of about 800 miles, more than two-thirds have been developed for shipping.

2. Certain sections of this improved foreshore have continuous lines of wharves and piers, e.g. a distance of nine miles from the Battery up the river on the New Jersey and Manhattan shores, and for six to seven miles on the East River between Manhattan and Brooklyn.

3. It is estimated that there are about 2,000 piers alone (some over 1,000 feet long) and mostly highly mechanised with expensive terminal equipment of cranes, store houses, etc. Incidentally, piers offer greater accommodation than wharves by reason of their construction.

4. The dockland area is served by some 300 motor truck lines and 10 railway lines which link the port with the whole country. In addition there are many other minor avenues of transport joining the various sections of the urban area.

Such developments represent the attempt to cope with a wide variety of dock and harbour-side activities of which the most important are:

1. The kind of industries which require to be near water, e.g.:

(*a*) dry docks, concerned with the building, repair and revictualling of ships, both naval and mercantile, as at Brooklyn.

(*b*) chemical industries, which need to assemble many raw materials for processing and local disposal, as at Jersey city.

(*c*) oil refining plants, where the waterside facilitates the import treatment, storage and export of crude and finished products in bulk, as at Bayonne, which also has oil line terminals and is one of the world's largest refineries. It supplies New York's vast demands; its presence calls for additional checks against fire and explosion damage to the city.

(*d*) storage of coal for industry, steam heating and railways, e.g. Hoboken.

(*e*) assembly of heavy machinery such as electrical equipment, e.g. Union City.

(*f*) the importation and treatment of foodstuffs before their distribution for local markets, e.g. sugar refining at Long Island city, and the Fulton fish centre in south-east Manhattan.

(*g*) generation of electricity requiring considerable water, e.g. the Hell's Gate station.

2. The many trading functions linked with the major imports of petroleum, raw sugar, coffee, tea, cocoa, fruits, nuts, crude rubber, gypsum, iron ore, flax seed, paper products, wood pulp and bags, as well as the exports of wheat, flour, hay and feed, oil, kerosene, gasoline, motor vehicles, coal-tar products, copper manufactures, scrap iron and steel. Some 35 per cent of the total exports of America pass through New York, while 50 per cent of the imports enter the port.

3. The kind of transport needed for the above and associated industries. This involves not only the actual movement of all kinds of commodities but the constant building and repair of various transport units. In order to understand something of the complex nature of this particular harbour activity, the following must be noted:

(*a*) the vast amount of ferry, lighter, train float, tunnel (subway) and terminal traffic between New Jersey and Manhattan due to

(*i*) rail and motor terminals on the New Jersey side with freight for distribution on the west Manhattan side;

(*ii*) liners berthing in Manhattan with cargoes for the New Jersey terminals.

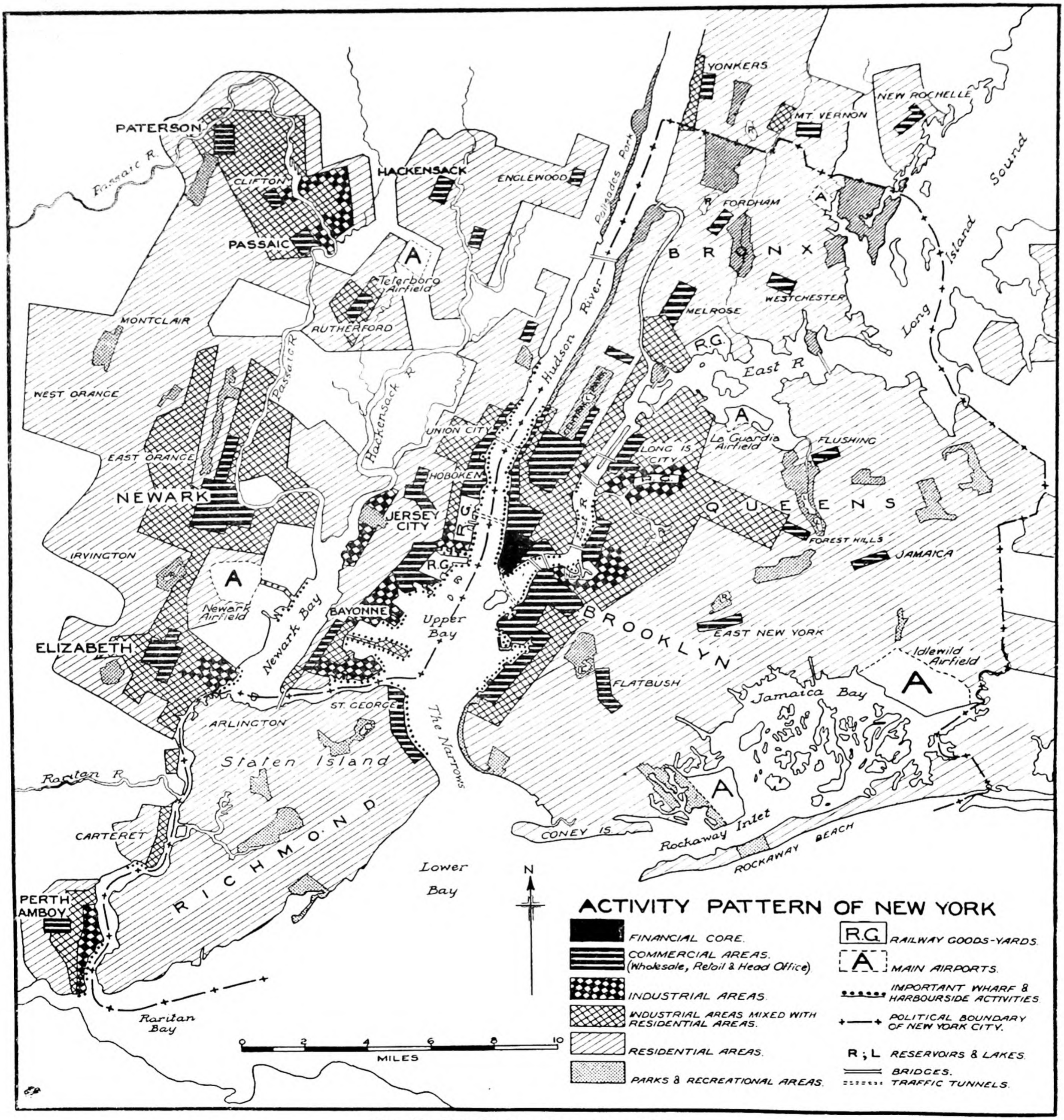


FIG. 45: New York: pattern of activities.

(*b*) a great volume of bridge and subway transport moving goods between Brooklyn, Queens and Manhattan; only smaller coastal vessels and lighters can move up the East River because of the series of bridges across it.

(*c*) the daily ebb and flow of millions of office and factory workers—commuters—across the rivers and harbour. For this reason the tip of south Manhattan has near and about it a series of ferry wharves similar to Sydney's Circular Quay.

4. The special functions of certain smaller islands e.g. Staten Island, where foreign trade goods destined for re-shipment are warehoused without clearing the U.S. Customs; Bedloes Island, the site of the famous Statue of Liberty donated to America by the people of France; Ellis Island, through which all immigrants to the United States must pass; Coney Island, the famous watering place and pleasure resort.

Although industrial New York surpasses all other manufacturing cities in the country, it is not a manufacturing city in the fullest sense. It is a trading post —for physical goods and ideas—with its enormous manufacturing activity, representing less than 30 per cent of its income, thrown in on the side. The secret of New York's power, therefore, lies in trade, including financial services and wholesale and retail trade. If these points are borne in mind interesting comparisons and contrasts can be made with Sydney and London.

Residential areas. First, a brief examination of the unique composition and character of New York's people.

(*a*) The total population of the political unit is about $7\frac{1}{2}$ millions, of which Americans of foreign descent number over 70 per cent.

(*b*) There is a cluster of peoples of all nationalities of whom the Italians and Russians (mostly Russian Jews), other Jews and Irish form the greatest number. The other principal groups of foreign-born peoples are Germans, Poles, Czechs, Hungarians, Scots, Swedes, Norwegians, Greeks, Danes and Dutch.

(*c*) Although these still exist in their own colonies—virtually cities within a city—present-day restricted immigration and the passing of the years are tending towards greater assimilation. The result is that a great deal of what is now considered to be peculiarly American is the contribution of these people.

(*d*) There are some 300,000 negroes who, although segregated, are increasing in numbers and providing a growing problem.

(*e*) New Yorkers as a whole tend to move about within the metropolitan area, mainly because of the predominance of apartments or flats as places of residence relatively close to places of work, and the many outside attractions offered by such a huge city.

With regard to the actual zoning of the residential areas, some comment has been made already on several localities, e.g. those associated with the industrial and commercial centres. To these may be added the following general features:

(*a*) In recent years there has been a movement of population away from Manhattan to Brooklyn (once an aristocratic section), the Bronx and outer dormitory suburbs, due to increased costs of rental and growing commercialisation of residential parts of the island.

(*b*) The lower east side of Manhattan continues to be one of the worst of slums; many foreign born lived and still live there, but numbers have moved out with their improved financial status.

(*c*) Within the three square miles of Harlem are to be found many thousands of Negroes, often living under deplorable conditions.

(*d*) Other than the above there are interesting aggregations such as at Greenwich Village on Manhattan, the mecca of artists, writers, musicians and theatre people.

(*e*) On the other hand, there has been a movement of the wealthy owners of homes along upper Fifth Avenue and Park Avenue to adjacent cross streets, Riverside Drive or Long Island. This has been forced upon them by steep rates, costly maintenance and the infiltration of commerce, and the consequent demand for apartment space for the employees. This can be paralleled by the movement of private home sites from the foreshores of Sydney Harbour to outer suburbs.

Taken together these aspects point to many pressing problems of New York's housing and it is difficult to give a clear-cut picture of the pattern within the shading shown on the map. A partial solution has been made by both Government and private business undertaking community housing projects. Many of these are virtually small garden cities for both lower and middle income groups, and because of the nature of this planning, considerable attention has been given to the provision of strategic areas of open space.

Parks and recreation areas. As the map indicates few large areas are devoted to parkland, but there are many smaller ones which cannot be shown. All told, over 22,000 acres of such space are now maintained. The following facts are notable:

(*a*) Almost all parks and recreation areas have been located in or adjacent to the built-up industrial and commercial localities with their accompanying residential suburbs. This is especially noticeable in the case of the satellite cities, where some measure of controlled planning was able to anticipate future expansion, and so make their park areas reasonably accessible.

(*b*) In attempting to cater for all age groups, there is a wide range in the types of recreation space, ranging from "city lungs" like Central Park, connecting parkways, highways, pleasure beaches and sports grounds to street playgrounds for children in congested areas.

(*c*) In catering for children, special attention is given to the use of school playgrounds and other play and community centres, under the special direction of trained directors. Many of these also have a swimming pool which can be converted to play space in winter.

(*d*) Certain spaces are used solely for special contests, spectacles and pageants, like the famous Madison Square Garden.

(*e*) Much of the city's shoreline is being developed along the available beaches with such improvements as pools, jetties, parking space and small sports fields.

Food supply. As in the case of other cities the supplies of food come from local, interstate and overseas sources and have localised markets within the city commercial area.

(*a*) In spite of its sandy and infertile soils, the New Jersey coastal plain is heavily fertilised and worked to support vegetable crops, poultry and dairy farming. As in the case of Sydney's rural-urban fringe, the advantage of proximity to markets offsets the heavy production costs.

(*b*) Bulk quantities of perishable commodities like milk come from places further out, e.g. Delaware, Connecticut and Pennsylvania.

(*c*) Many fruits and sugar come from distant points like Florida, California, and Cuba.

(*d*) Meats arrive from the mid-western and western States, but fish are available from the nearby waters of the bay, Long Island Sound, the Hudson River and Atlantic Ocean.

(*e*) Beverages such as tea, coffee and cocoa as well as special foods for the foreign population have to be imported from overseas.

A tremendous daily and seasonal movement is involved in the transport of all these foodstuffs, so that fast special trains, ships, refrigeration services and air lines are pressed into use.

Water supply (see Figure 44 for names of reservoirs). New York is fortunate in that, like Sydney, it has upland regions near by which can be utilised as watersheds for the collection and storage of a fresh water supply and at the same time brought to the urban areas by open channels, pipe lines and aqueducts. Nevertheless many problems have arisen over the years in keeping up adequate supplies to a fast-growing metropolis.

Many years ago New York's main supply of water came from artesian beds east of the city and the Croton reservoir on the eastern side of the Hudson River.

At a later stage supplies had to be drawn from the Catskill Mountains about 150 miles to the north and delivered into the five boroughs by aqueducts, and tunnels hundreds of feet below the surface.

In addition the problem was complicated by the location of a densely populated portion of the city on the island of Manhattan. Large siphons now take the water under the river.

Many quantities now come from the Delaware River system, which is equivalent to Sydney's drawing on the combined waters of the Hunter, Goulburn and Shoalhaven rivers of New South Wales.

The water is transported by stages through tunnels, one of which is 85 miles long with an average diameter of 15 feet. These place the supplies in a series of holding reservoirs (Wanaque and Kensico) on the northern boundary of the city. Before final delivery the water is aerated and chemically treated.

The water supplies for this large urban area are closely linked with a complex sewerage system and the daily cleansing of at least 3,500 miles of streets. This helps to explain why the present supply requires an amount of over 1,000 million gallons a day.

Transport. It is a difficult and growing problem to handle the many needs of transport in such a very restricted but densely populated area as New York City. The island of Manhattan alone may be likened to a huge ant-hill alive with continuous motion. And the ceaseless traffic of human freight is not limited to Manhattan, for there is always a heavy volume to and from the other boroughs of Brooklyn, the Bronx, Queens and Richmond as well as the New Jersey cities. The important aspects of New York's transport can be summarised as follows:

(*a*) Its major functions, determining both the complex nature and pattern:

(*i*) Handling the arrival and dispatch of people and material on the chief external transport lines (rail, road, water and air) from all U.S.A. as well as Canada and other countries. No less than 13 first-class railways focus the trade of the interior here. All this involves a huge *entrepôt* or "switch-over" type of traffic in itself, and accounts for the place on the map of a number of railway goods yards and airports. The railway works are concerned with either unloading of goods for direct use, or moving trucks etc. elsewhere for wholesale or retail disposal, e.g. Jersey city; in other words they are terminals and have as additional activities the building and repair of much rolling stock, since it will be noted they are all in the heart of industrial districts which can assist in this work. By way of contrast the airports are marginal to the city. On the New Jersey side are Newark and Teterboro, the latter handling only goods traffic. To the east the main ones are La Guardia and Idlewild, the latter the biggest field in the world and although being used is still under construction. The remaining airports are military ones.

(*ii*) Providing internal transport for commodities needed by food suppliers, and numerous manufacturing units, e.g. fresh food supplies from New Jersey.

(*iii*) Daily shifting of large masses of city workers, visitors and tourists (one skyscraper alone can house 15,000 office workers). Apart

from bridges, trains, etc., these needs are served by over 2,000 buses, 13,000 taxis and 350 miles of trams.

(*iv*) Social services transport of all kinds. For example, $1\frac{1}{2}$ million truckloads of refuse must be handled each year, being taken either to be burnt or dumped for reclamation purposes.

(*b*) The extremely intricate nature and diversity of transport are made necessary by reason of the fact that Manhattan is an island, involving many water ferries, subways and bridge construction. Today 56 vehicular and nine railway bridges, 24 ferry routes and 42 tunnels under the Harlem, East and Hudson Rivers, tie all the city parts together. Most bridges are on the Brooklyn side, but the majority of the tunnels are driven under the Hudson and will not interfere with shipping. At present a new tunnel is operating from Battery Park to Brooklyn for the same reason (see Figure 45).

(*c*) An interesting vertical transportation is made necessary by the skyscrapers. There are about 44,000 lifts in Manhattan alone, handling, apart from goods, some $12\frac{1}{2}$ million passengers each day.

In one respect New York transport is deficient, namely, in the lack of co-ordination of terminal facilities. This is but one result of the great limitation of berthing and handling space.

10

LONDON

The nodality of London. Figure 46 shows in part how London's nodality has led to its development as one of the greatest cities in the world.

1. Within the British Isles, London has relationships with all the important industrial and agricultural regions as well as with the ports serving them. This is achieved by a series of corridors passing through gaps like that of the Midland Gate.

2. With respect to the continent, London is situated on the Thames, the estuary of which faces those sections of western Europe where many great waterways and transport systems converge on important ports and trading and manufacturing centres, e.g.:

(*a*) the valley of the Seine and the lowlands of western France, as well as those of Flanders and Belgium, with centres like Le Havre, Paris, Dunkirk, and Antwerp;

(*b*) the valley of the Rhine and the lowlands of Holland and Denmark with important centres such as Rotterdam and Amsterdam;

(*c*) the outports of the Elbe and the west German plain, where Bremen and Hamburg are situated.

London thus has intimate contact with the heart of agricultural and industrial Europe.

3. Seaborne traffic to and from the Mediterranean

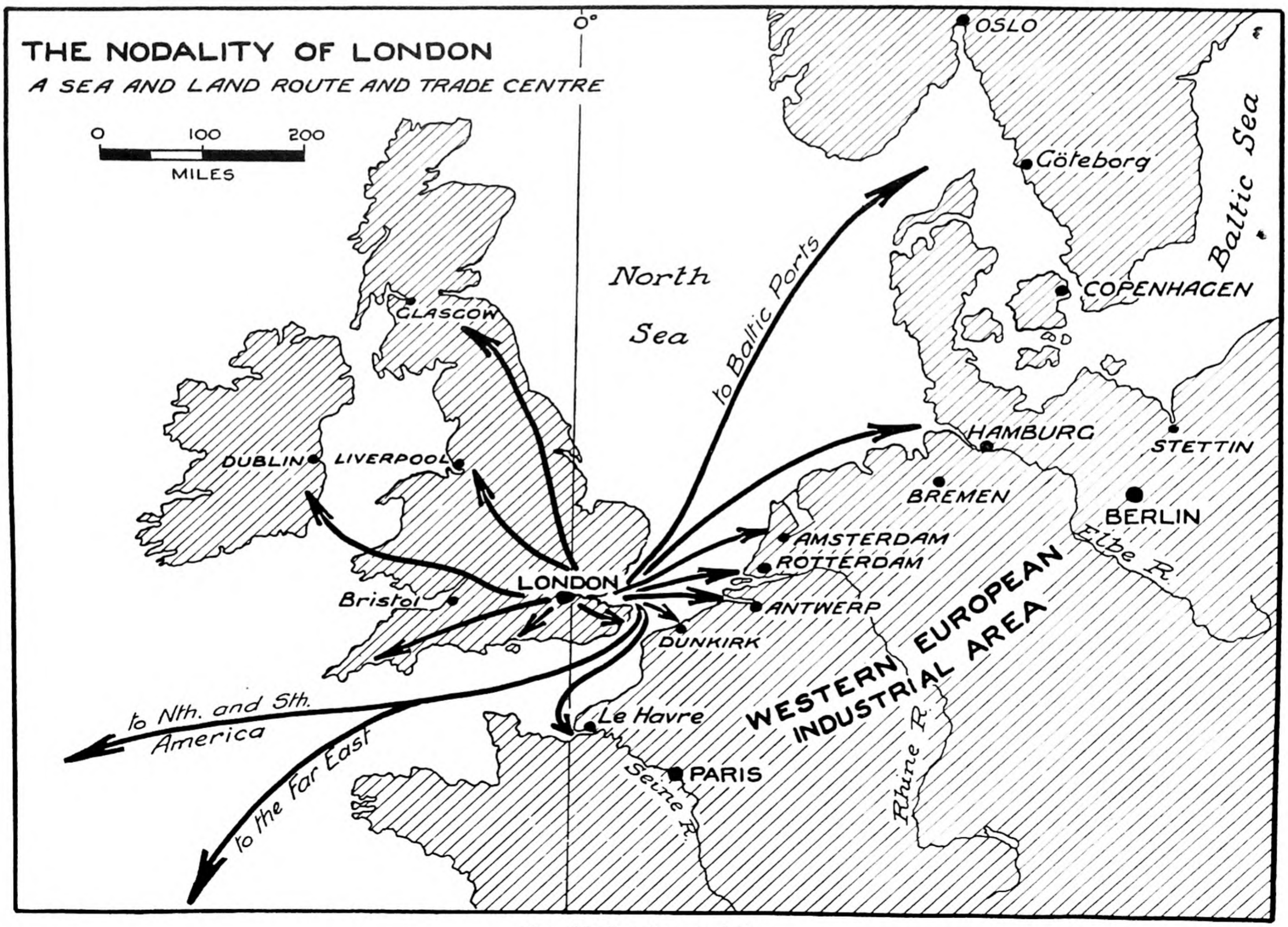


FIG. 46: London: nodality.

and the Baltic must use the Channel and so have London as a likely port of call on trading trips.

4. London is in a strategic position to act as an *entrepôt* for overseas trade with the Americas, Africa and the British Commonwealth of Nations. Not only is it a port of entry for enormous quantities of foodstuffs and raw materials, but it sends out a wide variety of manufactured exports to the countries just mentioned. Many goods are processed before being dispatched to other parts of the British Isles.

Generalised geological map of South-east England

The map and the generalised section of Figure 47 reveal the position and nature of the London basin in terms of physical geography and geology.

1. The basin lies between the North Downs and the Chiltern Hills.

2. It is a shallow hollow of chalk with a triangular-shaped valley formation, narrow to the west at the source of the Kennet River, and widening to the east where it is penetrated by the Thames estuary.

3. The actual valley is made by a syncline of chalk overlying a layer of clay (see Section; Figure 47).

4. On top of the chalk are the beds of sand, gravel and clay which in some parts have coverings of Thames alluvium from the deposits of the river.

All the above rock types and the structure of the basin have had interesting influences upon the subsequent development of London.

1. The structure of the chalk in relation to the other beds has favoured a good artesian water supply which was important for earlier London and is now drawn upon by certain industries, e.g. brewing; the adjacent outcrops of chalk have also been utilised for the making of lime, used in the building trades.

2. The clays and sands have been the basis of the brick industry, as well as making easier the construction of London's famous tube or underground railway system.

3. The river silts were excavated to form the great dock system and the reservoirs. They are important, too, in the market garden industries of London. The significance of the swamps and silts along the Lower Thames cannot be over-emphasised, for without them it is doubtful whether London could have constructed the wet docks which enabled it to maintain (and improve) its position as a great modern port.

There is also a valuable relationship with the areas immediately outside the basin and worth noting:

1. The clays of the Weald are taken up by both arable and pastoral agriculture, i.e. dairying, poultry, market gardening and the main occupation of fruit and hop growing.

2. The chalk of the uplands (the Downs) supports many sheep on the large pasture lands which grow only turf due to the porous nature of the rock. In the Chilterns it is mixed farming of dairies, orchards and gardens.

The drainage pattern of the basin shows three lots of streams, and these are:

1. Those of the upper basin, one of which, the Cherwell, rises in the limestone of the Cotswolds, and joins the Thames at Oxford, and the other, the Kennet, in the chalk of the Chilterns, meeting the Thames at the important gap town of Reading.

2. The rivers which have valleys reaching back nearly to the Chilterns, e.g. the Colne and the Lea.

3. The group of the lower course, like the Medway, Mole and Wey, which actually have their sources in the Weald but have cut gaps through the North Downs.

The actual location of London has a number of important historical aspects arising from its being a fording place, a fort, a river port, and a road and market centre. All these functions were the outcome mainly of successive settlements at just that point of high ground near where it was possible to cross the river nearest to its mouth. Further downstream the river ranges from a half to three miles in width, flowing through flat swampy marshland to the open tidal estuary, some 40 miles from the present location of the city. Over the years embankments and bridges have been built, docks and canals excavated and lowlands drained so that the river has become an important transport artery leading to one of the world's largest cities.

The county of London: suburban place names: parks and main steam railways. Figure 48 is intended as a reference for much of the geography of London which is described in the rest of the map series. Some of its features are:

1. A barred and dotted boundary line is drawn to indicate that London is actually one of the counties of England. It was set up as a county in 1889, with 28 boroughs covering an area of 117 square miles. Before then the name London was applied only to the city of London. Since then it has grown so much that the term Greater London is given to the city, the county, and the outer areas. Actually it now includes all the county of Middlesex and substantial portions of other counties, e.g. Surrey, Kent and Essex.

2. London's major features are:

(*a*) the better known suburban areas and their relation to the city proper and the river Thames;

(*b*) the principal rail lines and terminals, especially those in the west section, where the density of the built-up sections and the value of land stopped the lines from extending into the middle of the urban areas;

(*c*) the main parklands for which London is

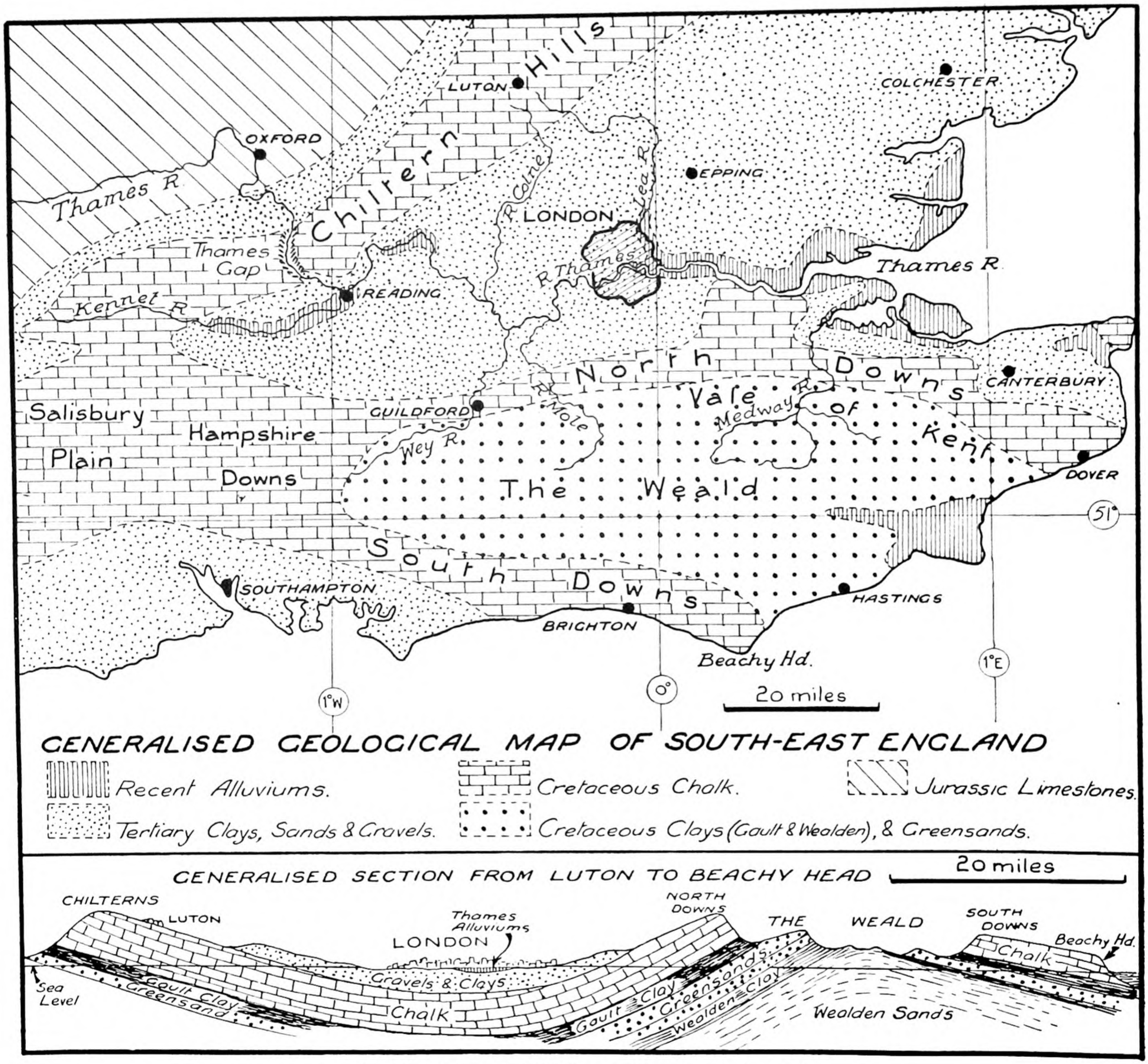


FIG. 47: London: geological map of south-east England.

famous, and of which there is a fair sprinkling, but elsewhere than in the more congested parts;

(*d*) the main canals, like the Surrey and Grand Union, both of which have special relations with the docks and the river, and all of which are dealt with at some length in later maps (see Figures 50 and 51);

(*e*) the reservoirs, of which the main ones shown here are those of Putney and Lea (the large one at Staines does not appear here but on the map of Greater London, Figure 50).

3. Interesting facts may be gathered by checking the relative size and locations of various features in this map against the scale shown. It is a useful exercise to make comparisons and contrasts with Sydney and New York distributions.

Activity pattern of inner London. By way of introduction to a study based on the key to Figure 49, several general points are made.

1. The general pattern follows roughly along the lines of the typical city plan as discussed in the previous diagrammatic illustrations (Figures 29, 30 and 31). There are the relative locations of city core, administration, retail business, industrial and other functional zones.

2. The river and its tributaries have played an important part in determining the ribbon-like type of settlement, with industry, for example, having strong ties with the waterfront, but spreading gradually to the outskirts along other waterways. Such influences by a physical setting can be compared with the harbour city sites of New York and Sydney.

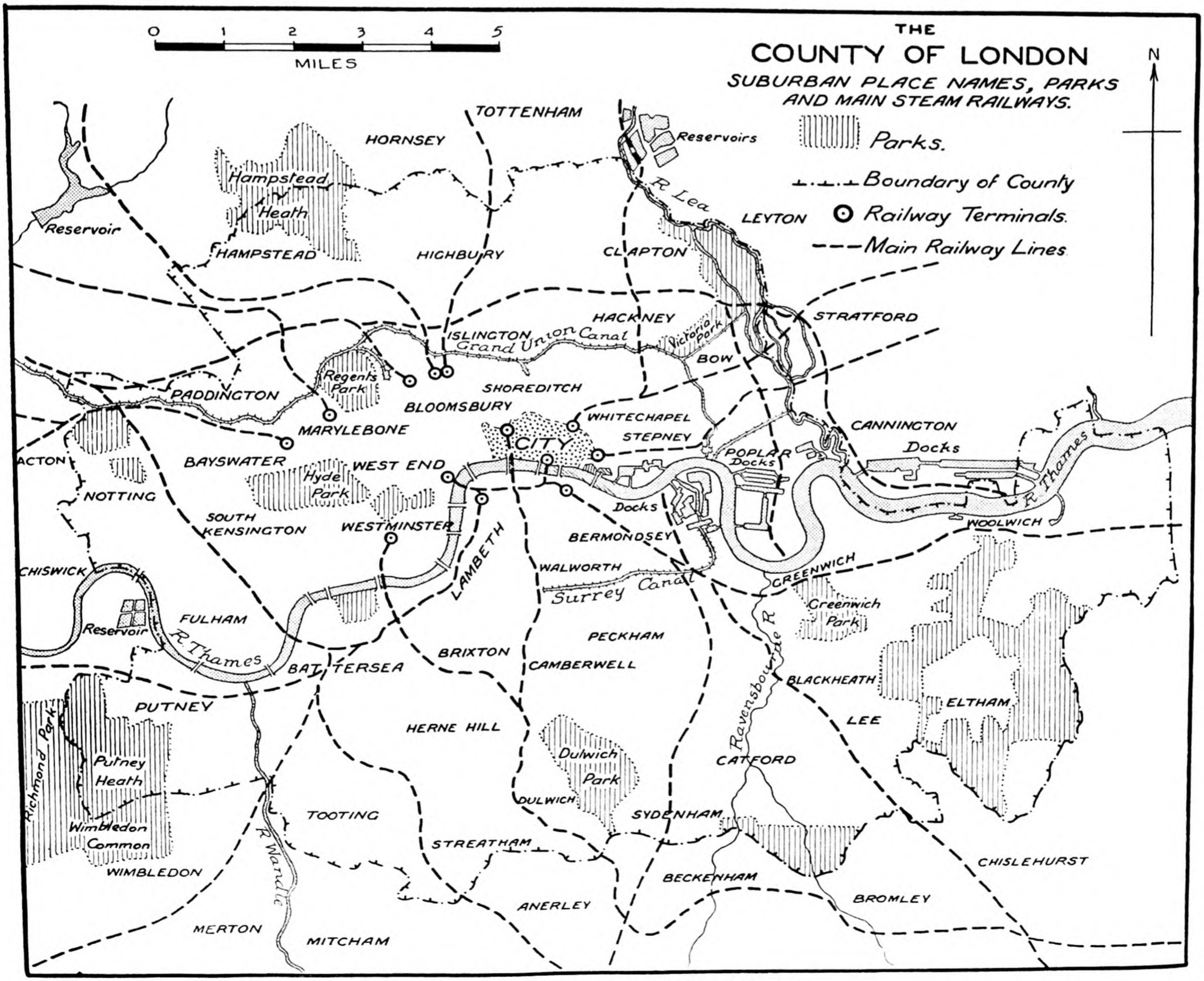


FIG. 48: London: locality map of suburban areas.

3. The historical geography of London also helps to explain the evolution of the present pattern of activities.

(*a*) the settlement of Roman times was associated with its function as a fording place and bridge town, a fort, and a nodal point for the routes from the continent and the radiation of the great roads built to reach all the other important centres of Roman Britain;

(*b*) the decay which followed the departure of the Romans and the subsequent fortifications by Alfred and the Normans;

(*c*) the growth of satellite settlements outside the walls and at other river crossings, and the development of the city as a port and market for local and continental trade;

(*d*) the tremendous impetus given to the port in the seventeenth, eighteenth and nineteenth centuries following the opening-up of America and other new lands, the Industrial Revolution, the advent of the steamship, and the construction of the great dock system;

(*e*) the resultant rise of London as a world centre of finance and manufacturing, and the over-all results on its expansion with much building congestion.

4. In more recent times London has undergone tremendous changes which also have a close relationship to its historical geography. The more striking features have been

(*a*) the growing significance of the city in civil and business administration, especially as the centre of the British Empire;

(*b*) the added stimulus given to the growth of manufacturing, trade and population by the increase in railway, water and sewerage facilities;

(*c*) the availability of more efficient electric and gas supplies and road transport, leading to the suburban expansion of light engineering and new residential centres adjacent to them;

(*d*) the movement of port activities and heavy industry down-stream with a corresponding trend in population, so adding to the decentralisation of activities;

(*e*) the advent of brilliant and far-seeing schemes for the re-planning of London, more especially since the destruction wrought by World War II.

The city core. This is the original site of the Roman city established on the banks of the Thames and as such is actually the oldest part of London. It is only about a mile square but within it are the office headquarters of most of England's great banks, shipping firms and trading companies. Here, too, are some of the famous market-places, the old metropolitan industries with skilled artisans, and Fleet Street, the home of many important newspapers. Historical features include St Paul's cathedral and London Bridge. Many buildings are old, the streets are narrow and traffic immense. Almost all the population of the city is engaged in service occupations and move out to dormitory suburbs in the evenings.

Government and administration. This zone lies immediately west of the city. Here along the Embankment and on higher ground is Westminster, with its many government and administrative departments such as the Houses of Parliament, Whitehall and the Courts of Justice. Across the river are the offices of the London County Council, which controls most of the important public services and utilities, including health and education. Because of its government character, foreign embassies also have their offices in this section. Westminster includes several centres of special historical and cultural interest, such as the Abbey, Buckingham Palace, Trafalgar Square, the National Gallery and the Kensington Museum. As a former fashionable home of the aristocracy, this part of the capital possesses a number of beautiful squares, buildings and fine residences. The cluster of buildings here is offset to some extent by the presence on its western side of the famous Hyde Park.

Retail shopping; hotels; cinemas; theatres. There is a more widespread pattern of these activities than those just described and they can be divided into several groups.

1. Centres closely allied with the above two zones, generally referred to as the West End and the East End. The former has large department stores, exclusive shops (as in Bond and Regent Streets) and expensive apartments. Leading theatres of London are located here and it is the national headquarters of the theatrical and musical professions. By way of contrast the East End caters for the dense industrial population near the docks on lowlying ground. Slum conditions prevail in much of it, poor type houses being huddled beside factories, small shops and boarding houses, which line the mean streets. Many of these buildings have been demolished to make way for re-housing schemes. Goods are often sold on open markets and cinemas provide entertainment. Well known parts are Whitechapel and Stepney, and the East End as a whole is the home of that famous London type, the Cockney. Buildings of special interest include the Mint and the Tower of London.

2. Various business cores scattered amongst those sections, where it will be noted that industrial activities are mixed with or very close to residential areas, e.g. Bloomsbury, Shoreditch, Islington, Hackney, Woolwich, Blackheath, Bermondsey, Walworth and Lambeth. Several of these have notable features. Bloomsbury contains many private hotels and boarding houses, and is the site of the British Museum and the newer location of the University of London. Shoreditch is the centre of London's furniture manu-

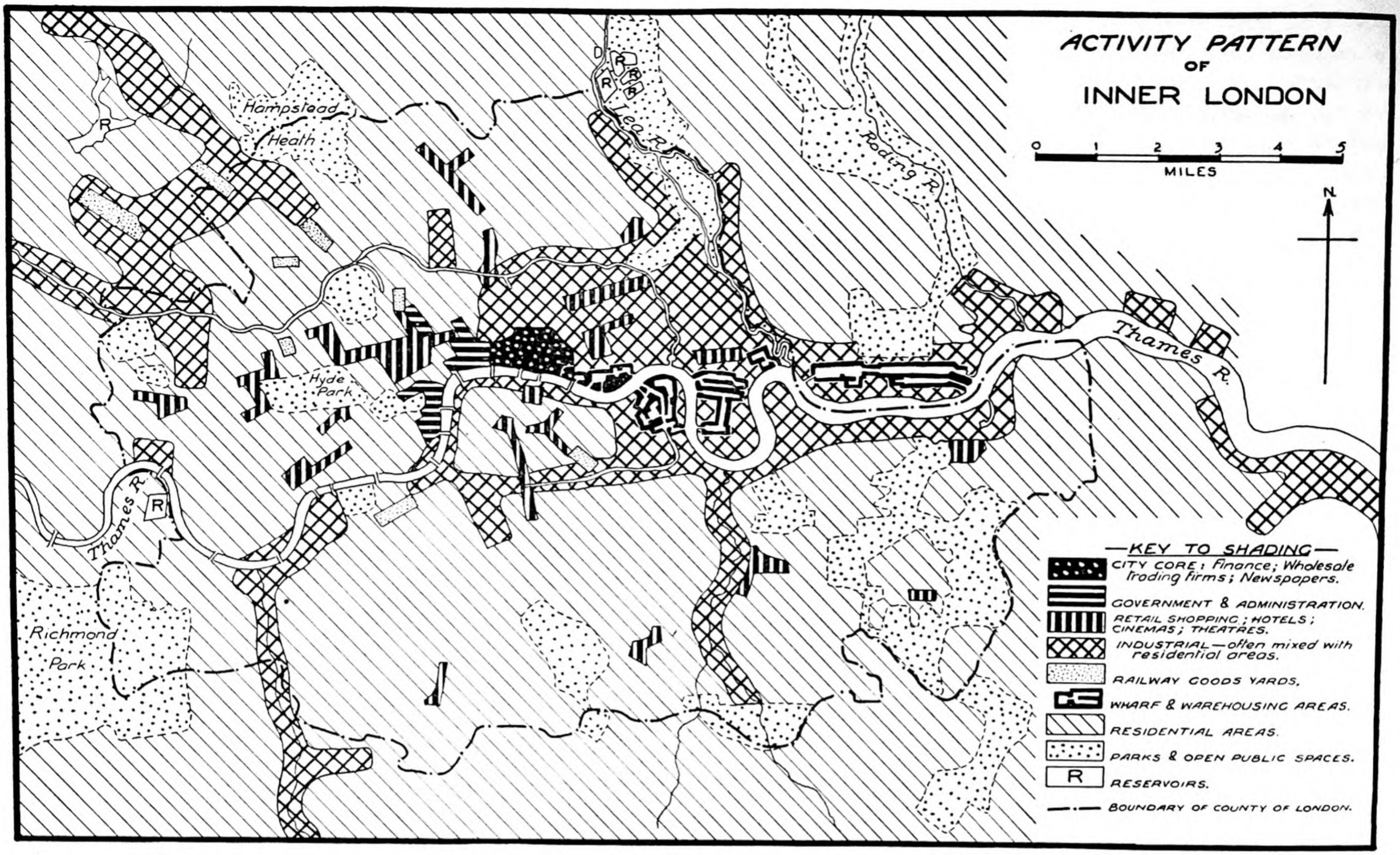


FIG. 49: London: activity pattern of inner area.

factures, which have spread to Hackney with an electric power station. Woolwich has the Royal Arsenal, which manufactures munitions, while Bermondsey has important tannery works and markets for leather and butter, much of the latter coming from Australia and being stored at Tooley Street.

3. Those which cater for the purely residential districts of London. The map shows these to be scattered, some being on the outer margins and often close to parklands. They include such suburbs as Eltham, Sydenham, Herne Hill, Kensington, Notting Hill, Marylebone (the site of the famous Lords Cricket Ground), Bayswater and Highbury.

Industrial (often mixed with residential areas). Although these are dealt with in some detail in Figure 50, some general comments may be made here to show how they fit into the over-all pattern of London's activities. As indicated in the key they are usually associated with built-up residential sections, the density varying with the location and type of industry. Looked at broadly, the areas may be divided into:

1. The major area which envelopes the city and East End and spreads out along the tributary valleys of the Thames. Industries here range from the lighter, very skilled types, e.g. precision instruments and style clothing of the inner city area to food and raw material processing about the docks and along the waterways, e.g. sugar refining, flour milling, gas making, drugs, heavier chemicals and light metals like cable and electrical goods. In the older sections factories are not efficient by newer standards and housing very congested. Some effective clearing has taken place and well-planned suburbs developed in the more recently established suburbs.

2. The western industrial area, which is one mainly of light engineering with newer types of factories lining the arterial roads. They make a wide variety of goods such as motor and aircraft parts, paper boxes, radio receivers, furniture, and boots and shoes. Foodstuffs are also produced, e.g. breakfast foods. These are characterised by ribbon development and houses strung out along highways or massed in new estates.

3. The lower Thames where the heavier types of industries are located. These include such activities as cement- and paper-making and ship repairing. Settlement is not as intensive as in the above, but in recent years it has tended to move downstream.

4. The recently developed manufacturing zones on the outskirts of the city. Here many new and efficient factories have been set up with good access to transport and planned garden types of suburbs to cater for the employees. They are mostly light engineering

firms who specialise in making clothes, light metal goods such as electrical equipment and floor coverings.

Railway goods yards. These are also illustrated more fully in Figure 50, but the opportunity is taken here of noting how they are located with reference to various other aspects of London's pattern. A striking feature is their grouping to the west and north-west of the city, since that is the general direction in which the railways approach from the upper sections of the basin. Yet they do not penetrate the heart of London because of the great density of occupance and the high cost of land there. In any case they have a close link with road transport, which assists the yards in the handling of foodstuffs, raw materials and manufactured goods both to and from London. Only two yards exist on the south side of the river, one being very close to the docks.

Wharf and warehouse areas. These refer to the intricate and highly important dock system of London, to which a special map (Figure 52) has been devoted. We note here how they are located virtually in the heart of London or very close to it. There are many interesting historical and geographical facts behind this which are examined elsewhere (see pages 83, 84, 87). but here it brings out the very close link between London industries and the waterways. There is also a close relationship with the transport of London, since many goods which come to the docks from shipping have to be moved out by road or canal. In many instances they are lightered first, which is in marked contrast with the direct off-loading of Sydney Harbour, but which has much in common with New York. The railway termini mentioned above have an active partnership with the docks in taking away to other parts of England goods which come through London. Hence the importance of the many warehouses, which store commodities while in transit.

Residential areas. Over 50 per cent of the people of London are engaged in service industries, i.e. as transport workers, in clerical occupations, commerce, public administration and professional work. But many of these, as well as factory and mill workers, are scattered all over the huge area of London, with some general zoning recognisable in the following way:

1. Inner residential areas of the city dwellers. These are often of the service group mentioned above and occupy apartments over shops and so on or live in large blocks of flats which are becoming more common with clearance and rebuilding.

2. Inner suburban areas, which may be occupied by dockworkers and factory employees about the East End. Here, too, are the homes of the workers in heavy industry and other activities of the riverside.

3. Outer residential areas, where are to be found many office workers and employees of the outer belt of new factories mentioned above. They have been associated with ribbon-development, the construction of homes in lines extending along either side of the main roads. On the other hand there have developed a number of fine new residential sections with full allowance made for community recreation and amenities. One of the best known is near the great motor works at Dagenham. The gradual realisation of the famous London Plan should do much to solve the difficult residential problems of London.

Parks and open public spaces. One of the striking features of this map is the large amount of open space shown. London has over 50 parks comprising within the county some 4,000 acres. The largest is Richmond Park and possibly the most famous is Hyde Park. They have a particularly important bearing on London's pattern since their scattered nature offsets the general density of buildings. They are also important for recreational reasons, offering as they do beautiful scenery as in St James Park, or games as in Hyde Park. Future plans envisage measures to increase open spaces, more especially those on the outskirts, which are in great danger of being engulfed by the spread of buildings.

Reservoirs. The two main ones shown here are those in the Lea Valley and near Staines. These are actually filtration and holding reservoirs, the water being pumped in the first instance from the Thames itself and its tributary, the Lea. The water is now distributed far beyond the boundary of the county of London shown here and the demand from industry and for domestic purposes is very great.

Greater London—the pattern from industry (Figure 50). London is the greatest manufacturing city in the British Isles, and in order to understand the pattern of its industries as shown here, it is first necessary to make some general observations:

1. Note the general spread of industry in relation to the boundary of Greater London: included within it are almost all the areas mapped.

2. On the whole there is a distinct relationship between the location of industry and the Thames River with its various tributaries and dock system.

3. Industries plotted may be divided into several characteristic areas:

(*a*) the main industrial area of London, which consists of

(*i*) the central industrial core around the city and the East End;

(*ii*) the eastward extension from this along and through the docks into the Roding valley;

(*iii*) the southward extension along the Ravensbourne and Wandle valleys;

(*iv*) the northern extension along the Lea valley.

(*b*) the western industrial area, which is de-

veloped about the railway termini and goods yards and adjacent to the canals;

(*c*) the lower Thames area, especially on the south bank opposite Tilbury and along the Darenth valley, where are major riverside industries;

(*d*) the series of more isolated areas, which may be described as satellites to the above, including such centres as Molesey, Staines, Watford, Boreham Wood, and Southgate and outside of which again are places like the Luton area.

4. In relation to all the above it is worth noting that in more recent times expansion has been away from the central riverside area and along the major roads, rail lines and canals. This has led to considerable ribbon development and the establishment of satellite areas specialising in the lighter metal industries such as electrical equipment, wireless and household materials.

Certain geographic factors have been important in the localising of London's industries and of these the following are especially significant:

1. The general location with respect to a large estuary and the European mainland to the east, and the remainder of the British Isles to the south-west and north.

2. The site on level land, which has made building relatively easy. It has also made possible the more recent expansion of industry to cheaper factory sites on the outskirts of the city. Some interesting comparisons and contrasts can be made here with both Sydney and New York.

3. The nature of the immediate rock structure, by which the chalks have assisted in water supply and lime-making, the clays in making bricks and aiding the building of the underground railways, and the silts in the construction of docks and reservoirs.

4. The importance of the Thames and its tributaries in providing water supplies and cheap transport for the handling of bulk raw materials and of fuels for sources of power, since London has none.

5. The dock, railway, road and canal systems, which aid in the dispersal of imports and processed goods. There is also the movement of millions of people annually to and from as well as inside the city.

6. The availability of electricity and gas supplies as efficient sources of power to industry.

7. The labour supply from London's huge population provides a major market for the commodities which come from many of its industries.

In the London area it is not possible to work out very definite localisations of industry beyond a certain point. This is because it is a region where nearly everything is made so that there is a complex occupance by many kinds of factories, mills, offices and houses. For the purpose of the study being made here, the actual mass of small industrial centres may be zoned in the following way:

1. The riverside and general port activities. These are illustrated in some detail in subsequent maps (see Figures 51 and 52). Their particular localisation, adjacent to the main streams, docks and canals, has been determined mainly by their immediate concern with the handling of imported and local materials in bulk. This in turn demands water transport, water supplies, dock facilities, easy dispersal of the finished products, and, in the case of the heavier industries, large areas of land for the building and expansion of plants. Thus:

(*a*) In the lower Thames area are to be found such undertakings as cement-plants, paper mills, petrol refineries and storage tanks, dockyards, e.g. Tilbury, and the new and larger motor works as at Dagenham.

(*b*) In the central riverside area are many electricity and gas plants as well as sugar and flour mills. Other food processing factories are also located close to the major dock areas. Here, too, are timber mills and industrial concerns making soap, fertilisers, paints and beer. Large foundries and small engineering firms concentrate here, specialising in such trades as the manufacturing of cranes, boilers, cables and marine repairs.

(*c*) In the Lea valley are the chief chemical works, away from the city because of their fumes, and providing alkalis and acids which are basic to many other industries like the soap, rubber and plastics trades. The lighter chemical industries, e.g. drugs and medicines, are not so well defined in the situation, but are still fairly close to the riverside so as to use water to handle bulk imports. Other industries include a miscellany of cable-making, radio, woodworking and stationery.

(*d*) In the Wandle valley there is a variety of engineering firms with interests in cable and electrical equipment, paints, varnishes, toys, and foodstuffs including sweets and margarine.

(*e*) In the Ravensbourne, Roding and Wandle valleys are newer extensions of industry in many cases concerned with those industries which have moved out from the congested inner area into larger factories. This movement should be compared with that now in progress in Sydney.

2. The light industries of the old metropolitan area. These consist almost wholly of small establishments, many of them belonging to the same firms for years. In this way they form some marked contrast with the heavier industries in the same central riverside area. They are to be found in places close to the city and about the docks, e.g. Poplar, Greenwich, Bermondsey, Walworth, Camberwell, Lambeth, Battersea, West End, Blomsbury, Shoreditch, Hackney and Stepney.

The industries are innumerable, but a rough classification would show the major ones to include:

(*a*) *Clothing trades.* Many women are employed

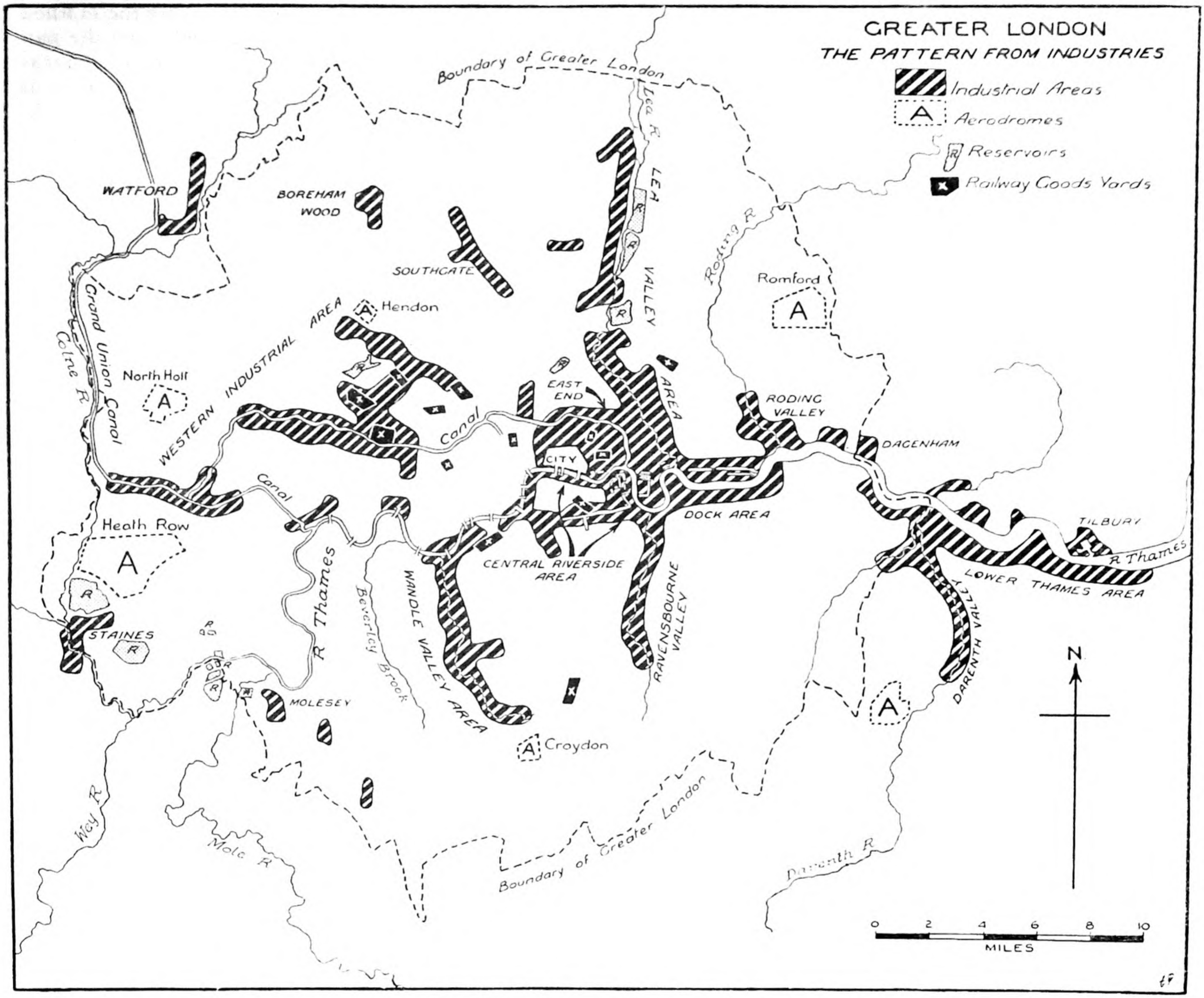


FIG. 50: London: pattern from industry.

in small factories for the mass production of ready-made garments, especially in the East End. The West End is the centre of the fashionable tailors. An interesting comparison can be made here with the garment industry of New York.

(*b*) *Footwear manufactures.* There are similar features in this industry. Its localised character has been derived from the riverside imports and tanning activities about the Surrey Docks.

(*c*) *General processing of foodstuffs.* These have always been situated on or near the Thames front, where the raw goods are imported and stored. Production includes meats, drinks (beer mainly), tobacco, sweets, jams and pickles.

(*d*) *Furniture-making.* Furniture has to be made to meet the vast domestic, industrial, commercial and professional needs of London's population. Since the necessary timber arrives mainly in bulk, factories have been set up near the dockside yards and mills.

(*e*) *Paper and chemical industries.* The paper trades handle the produce of the larger mills of the lower Thames to make newsprint, cartons and stationery, while ink-making is an associated activity. Chemical industries are of the type that engage in converting bulk riverside imports into gas, oils and drugs.

(*f*) *Light metal trades.* These have been the special field of skilled artisans for many years and as a result are located in the heart of London. Their main activities embrace such precision work as clock-

and watch-making, and manufacturing scientific instruments and jewellery.

In most of these areas the congestion of industry is so great that the problems of slums and traffic movement have become very serious and are being tackled by planning and clearance schemes. Some relief can be obtained by the growing tendency of certain industries, e.g. furniture-making, to move out to new suburban sites, where substitutes like light metals and plastics can be made more easily. This movement has been aided by the growth of road transport, which, however, does not seem to affect the close city and riverside ties of the food, clothing and chemical industries.

3. **Suburban and new industries.** During the last quarter of a century there has been a phenomenal growth of industry in and about London, with the most striking development in the outer areas. Important factors have been growing markets, ample raw materials, abundant labour, efficient transport, cheaper land, rates and rent, as well as the advent of more electric power. As a result many fine types of factories have been erected in good surroundings with well-planned residential suburbs. In many cases they are engaged in light engineering, and the best examples are:

(*a*) *The western industrial area.* Here there is a very miscellaneous group of industries which produce such a wide range of articles as motors, aircraft and electrical goods, railway rolling stock, chemicals, furniture, paper, and foodstuffs.

(*b*) *Boreham Wood.* This centre has light chemical and engineering plants, but is best known for its large studios, it being one of the main locations of the film industry in the country.

(*c*) *Watford.* Factories in this district are engaged in the making of chemicals (paints and dyes), clothing, paper (also printing), as well as metal manufactures and the treatment of foodstuffs, drinks and tobacco.

(*d*) *Staines.* There is some light engineering, but it is better known as the centre of the linoleum industry.

There are several other features on this map which have a definite relationship with industry and so need some comment. These are the railway goods yards, waterways, aerodromes and reservoirs.

1. **Railway goods yards.** Important railway terminals are generally in the city proper or adjacent to it, that is, on the outskirts. These are associated with the movement of both people and goods. In Figure 50, special attention has been given to the location of the yards, not only because of their work of making up trains, but because they are significant for many types of industry. While the waterways bring in much of the bulk goods for treatment and processing, the railways do more in the way of dispersing the finished goods. For this reason it is interesting to see the pattern of the yards in relation to the industrial areas just described, especially in the western section. It is here, too, that the larger railway engineering workshops are to be found. On the whole the functions of the railways in this work are regarded as effective; but future plans envisage the reduction of goods stations and more distribution and collection over wider areas by means of road transport.

2. **Waterways.** The navigable waterways are the oldest means of transport, but actually they are least used by industry in London today. Nevertheless they have important functions still, which include their attachment to the docks for transport to warehouses, short distance movement of commodities as on the Thames, and long distance transport as with the Grand Union Canal. This last-named is especially valuable because it maintains a connection with Birmingham, which is the centre of the national system of waterways and of the industrial Midlands, one of the country's chief areas making goods for export. In addition to actual transport, the waterways are connected with mechanised equipment for handling goods, warehouse storage, fleets of lorries for distribution from canals, and a special system of control of tug and barge traffic on the canals.

3. **Aerodromes.** These are on the outskirts of the industrial areas at distances ranging from 10 to 20 miles from the city core. Their function is to handle a large traffic in passengers and lighter goods. There are increasing links with the rest of England, the continent of Europe and overseas which have necessitated the planning of a ring of some ten aerodromes in all. These do not take into account military installations. The location of the airfields has stimulated expansion in the aircraft industries about London, mainly of the lighter type, as in the western area near Hendon.

4. **Reservoirs.** Apart from the immediate need to supply water to the residential areas of London, the reservoirs play an important part in aiding the work of industry. This has been achieved in part by locating the storages near industrial centres, as can be seen here. Much of the water is pumped from the Thames and the Lea first to filter beds and then to artificial reservoirs. At the same time several industrial concerns like breweries draw upon the hard waters of the underground chalk beds by means of artesian wells. As in all cities there is an intricate system of collection, holding, treatment and distribution of the London water supplies.

5. **Roadways.** These have a special function in transporting bulk and manufactured goods into and from the region. They are responsible for moving large numbers of industrial workers by bus. London's roads today pose an urgent and growing problem for

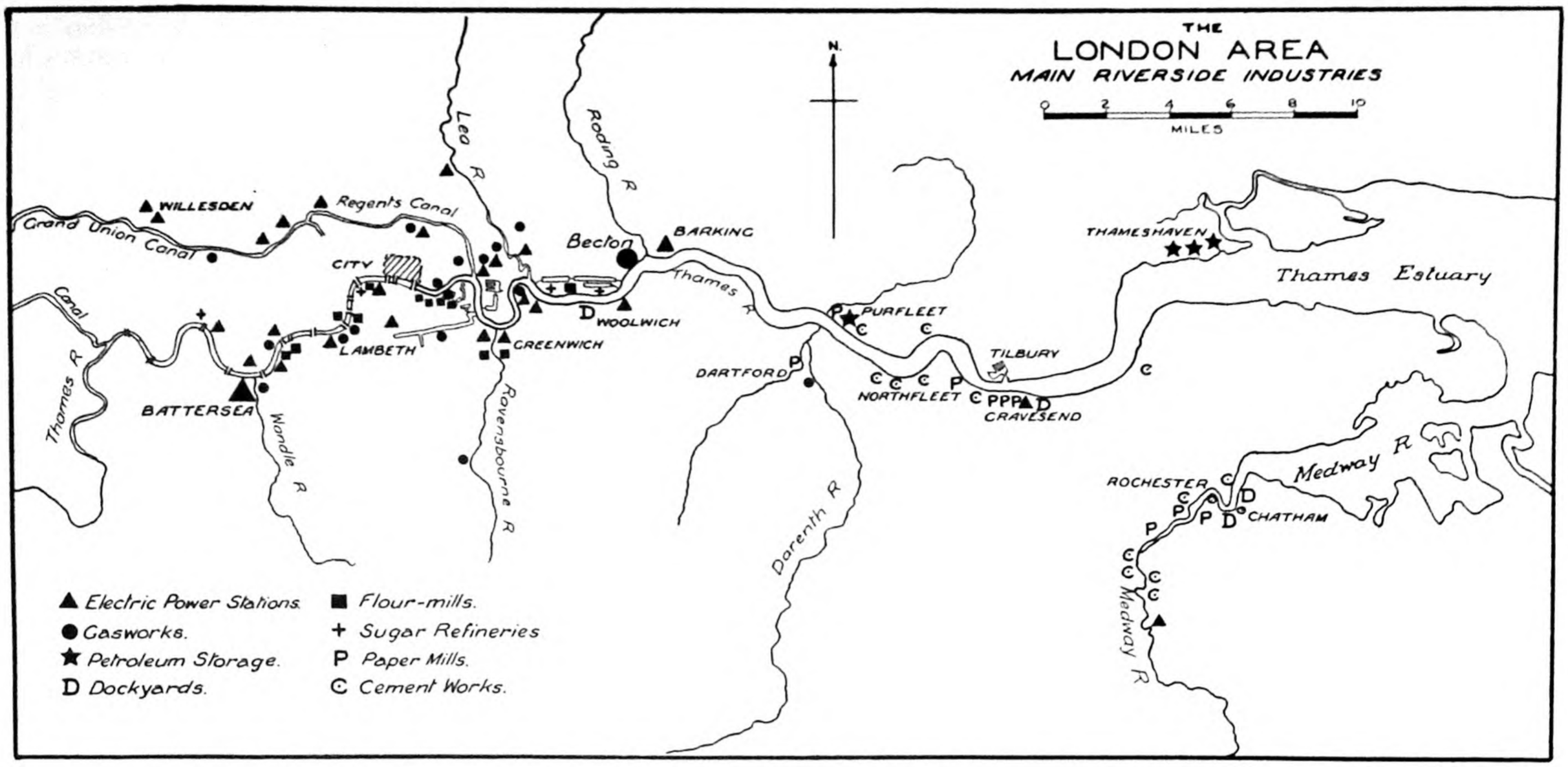


FIG. 51: London: main riverside industries. (*After Rodwell Jones*)

both population and industry. This is because, apart from a few improvements, the roads are much as they were a hundred years ago and yet have to carry an increasing number of goods and people. Future plans will attempt to provide a series of circular highways to prevent congestion in the areas where they now converge, and at the same time encourage a further dispersal of industry and residential areas. As it is, the growth of industry and accompanying roadways have led to industrial ribbon development as on the Great Western Road. In spite of the modernity of the factories this has destroyed the efficiency of arterial highways and created more dangers for motor traffic and civilians. In addition, the intense concentration of industry has frequently meant the absorption of excellent agricultural land, and the creation of housing difficulties. London's road problems are closely bound up with those of the present and future expansion of its industries.

The London area—Main riverside industries (Figure 51). The precise location of industries on the banks of the Thames, the Medway, along the Grand Union Canal and beside the docks, is determined mainly by their concern with the use or treatment of imported or local materials, the resultant products generally being absorbed locally or in the British Isles.

Examples of this are

1. Electric power stations and gasworks. Coal is the basic raw material for these services, which supply both industrial and domestic needs. Since it is a bulky material, the most economic way of distributing the energy from it throughout London is by means of gas-pipe and electric cable from river-side works. Hence a large proportion of the coal arrives by water, since it can be carried more cheaply that way from northern mines, provided it is handled finally by a Thames-side plant. Large and efficient works of both types are now operating throughout the section of the river shown here. Some are able, on the lower river, to unload direct from colliers of up to 5,000 tons; but the upstream plants receive supplies by lighter. Coke is mostly distributed by road and rail, but other by-products generally go by water. Some of the largest plants are at Battersea, Willesden, and Becton (one of the world's biggest gas works).

2. Flour mills. These are located along the upper sections of the river in the vicinity of the city. Grain is unloaded in bulk by suction into silos or lighters in the docks and then taken upstream to river-side mills or wharves. In some cases the mills are located close to the dockside, e.g. the Royal Docks, and the flour is dispatched by road and rail facilities.

3. Sugar refining. Sugar refining requires bulk handling, plentiful supplies of water and large plants, and so it is logical to find it as a waterside industry. London has always been one of the world's sugar markets and the largest refinery in Britain is at Silvertown, which lies between the Royal Docks and the riverside, opposite Woolwich.

4. Paper mills. The production of paper of the cheaper variety for newsprint demands the bulk hand-

ling of heavy material like wood-pulp, coal and clay. The pulp is imported from North America and Sweden (but esparto grass also comes in from North Africa) and unloaded at Thames-side mills, of which the best known are at Purfleet, Gravesend, and Aylesford on the Medway. In this way they have a close connection with the paper presses of Fleet Street, to which the rolls are taken by water or road. There is also a big consumption of better-class paper by government and private offices as well as by book-publishing firms.

There has been a more recent spread of riverside industries downstream, except of course, for the older docks and shipbuilding yards at Gravesend and Chatham. In general the reasons are to be found in the types of industry needing much space on open land for their operations, abundant soft water, distance from the residential areas by reason of objectionable and noxious fumes, and avoidance of fire risks which might be associated with the actual processing operations. The best examples of these are:

1. Petroleum refining and storage. The main centre is that of Thameshaven, which is a big expanse of drained marshland (for storage tanks) and at a considerable distance from built-up areas because of the inflammable nature of the commodity. Refining at this spot provides petrol, lubricating oil, paraffin and greases for much of London's transport. Petroleum products for the rest of England are most easily dispersed from this north bank location.

2. Cement works. The raw materials for the manufacture of cement are chalk (burnt for lime), dried clay finely ground, and coal (a source of power). Except for the last-named these bulky products are almost on the spot and easily moved by water to the site of the processing plants at Purfleet, Northfleet and Rochester. More than half the cement of Britain comes from these Thames works. Some is distributed by rail, but most by barge to cement wharves or docks for loading on export vessels which frequently carry it cheaply in place of ballast.

The tremendous number of wharves which line the Thames, with their huge warehouses, may be regarded as an industry devoted to the handling of general and specialised cargoes. This is especially the case in the upper stretches of the river, where many of the industries cited here are located. As well as these there is a multiplicity of industries with riverside connections, including such types as soap works, oil-seed mills, paint and varnish works, linoleum- and rubber-making, rope works, foundries, chemical industries, electrical cable making and artificial manures. Many have elaborate plants near or on the river embankments and trade with British and overseas buyers.

Of recent years the trend of industry has been along the lines of most large cities, that is, a dispersal to satellite townships on the city fringe. In the case of London river-side industries the major expansion has tended to be downstream, especially if the establishment demanded large areas of relatively open land as with the great new motor works of Ford's at Dagenham, below Barking.

The London docks (Figure 52): Historical geography. It was the practice for centuries to handle the cargoes of the small and shallow draught ships which came into the Pool of London by anchoring or beaching the vessels. But it gradually became necessary to provide berthing spaces and these developed into a series of wharves, quays and warehouses. By the end of the eighteenth century there was not only an insufficiency of these facilities to meet the increased river traffic, but ships of bigger tonnage, which wanted to load and unload as near as possible to the business houses of the city, could only operate at the wharves in the main section at high tide, as the tidal range is over fourteen feet.

A continuous and serious congestion developed, added to which organised smuggling and plunder of anchored ships became a definite problem. On the whole, the delay, loss and inconvenience to shipowners and merchants resulted in the appointment of a Parliamentary Committee in 1796 to investigate ways and means of overcoming the port's difficulties and improving its trade facilities. The most practical proposal was submitted by a group of West Indian shipowners and merchants who advocated the construction of wet docks which would permit the loading and discharge of goods to be carried on in spite of tidal changes as well as providing plenty of space for the safe storage of cargoes.

Such a plan was made possible by certain aspects of the geography of the Thames River itself. Thus (*a*) there were huge tracts of useless and uninhabited marshland reaching from below the Pool almost to the sea; (*b*) alluvium deposits were easy to excavate; (*c*) there were strips of land enclosed by the river's meanders which permitted docks to be built across them in such a way as to have entrances at both ends; (*d*) there was the possibility of placing the docks on the north bank so that transport would not have to cross the stream.

The West India Docks were accordingly built by a private company and opened in 1802. Their subsequent success led to the construction of a whole series of docks, warehouses and wharves extending further and further downstream towards deeper water.

This went on throughout the nineteenth century but the different companies became so involved in ruinous competition that it was evident they could not carry out any co-ordinated programmes of improvement and reconstruction, while the trade of the port was losing seriously to its rivals of Hamburg, Liverpool and Southampton. Government attention to the position resulted in a Royal Commission which

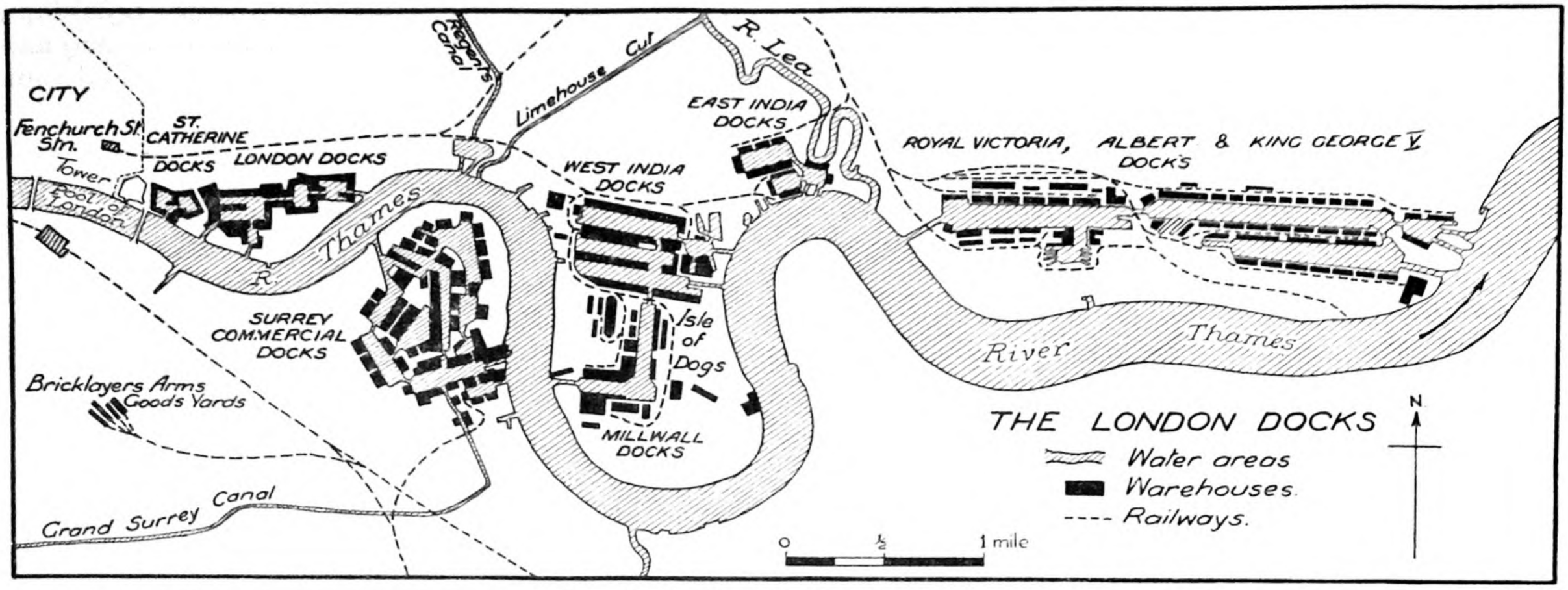


FIG. 52: London: the London docks.

in 1909 set up the famous Port of London Authority which still operates as a public trust. It consists of 28 members drawn from various bodies such as the Admiralty and London County Council, and representatives of the shipowners, merchants and other users of the port. Its work is to control all the activities of the port and its thousands of employees, so that it is not only engaged in matters relating to navigation and the supervision of river channels, but in the improvement and construction of docking facilities and the provision of large storage accommodation. In all its activities the P.L.A. is not subsidised by any other authority because its charges produce sufficient revenue to cover its operating costs.

The Port of London today has several features worth noting:

1. It includes some 70 miles of the tidal Thames.

2. There are five great dock systems with an area of over 4,000 acres, and a quay length of some 44 miles.

3. Each dock is so constructed and mechanised that it can handle any type of work and all variety of goods, excepting those, of course, which specialise in repairs and overhauling.

4. In contrast with the ice problems of some of the continental ports the river and docks are never frozen over.

5. Adjacent to the docks there are miles of wharves along the banks of the Thames and these are operated by private factories and companies concerned with the production of such important products as gas, oil, and electricity.

6. There is an extensive use of 8,000 to 9,000 barges or lighters which ply between the docks, quays, ships and wharves. They range up to 100 tons and provide an important internal traffic for the unique nature of the river with its long banks and scattered shipping facilities. It is estimated that they handle over 80 per cent of the port's goods. Closely associated with the barges are the tugs, which also handle large ships. Nowadays many barges are self-propelled.

7. Several of the docks are joined by both railway and canal communications which assist in the speedy transfer of goods, while road transport has become increasingly important. This is especially the case with the more recently constructed docks.

8. There is a close and significant connection between the commercial and business centres of London and its port, e.g. the tea and woollen trades.

London and St Catherine's Docks. These are near the city heart. St Catherine's Docks were opened in 1838, and as the smallest in London are used by light tonnage boats. They handle continental and coastwise trade in such valuable goods as wool, rubber, ivory, spirits, wine and spices. Much of this is carried to the warehouses from downstream by lighters and road transport.

Surrey Commercial Docks. These are the only docks on the south side of the river. Their main work is the discharge and storage of softwood timbers from North American and North European ports. It is here that they are seasoned in special sheds or floated in ponds. It should be noted that the Grand Surrey Canal enters the Thames via these docks. Its purpose is to provide waterside facilities for the factories and timber wharves. On the opposite side of the river the Regent Canal Dock is found as part of a canal system carrying traffic between the Port of London and the Midlands, as well as to the western industrial area of London—an area illustrated in the map showing the pattern from industry.

The Docks of the Isle of Dogs. Within the loop of the once swampy area known as the Isle of Dogs are to be found the great docks of Millwall and West India. These were two separate systems up to 1929, when

cuttings were made to help ships move from one to the other. The oldest in London, the West India Docks, were built originally to cater for West Indian trade, and they still specialise in such commodities as sugar, rum, bananas and hardwood logs. Millwall began working in 1868 and today is the port's biggest handler of grains, which are discharged by pneumatic elevators sucking them from the holds of the ships into giant granaries.

The East India Docks. Further downstream are the East India Docks, first constructed in 1806 by a branch of the famous East India Company, which opened up British trade with India and the East. It was from these that wool and tea clippers of the nineteenth century sailed. To this day the docks handle special eastern cargoes such as tea, silk, and the major part of the London fruit trade in bananas. Pedigreed stock from all over Britain are first quarantined here before being sent overseas. There is also considerable business with the Mediterranean.

The "Royal Docks" System. These consist of the Royal Victoria, Albert and King George V. docks, but actually they form one huge dock divided into three sections, in all the largest sheet of enclosed dock water in the world, covering 245 acres. The following are some details of each of these:

(*a*) The Royal Victoria Docks were opened in 1855 but have been partly re-constructed so as to afford more storage space and to substitute a straight quay for a series of jetties. They handle grain in bulk, the cargoes being discharged direct into several large flour mills nearby.

(*b*) The Royal Albert Docks were first operated in 1880 and they now handle most of the frozen and chilled meat imported into the United Kingdom. Much work is done here in sorting and storing goods, both after importing and prior to export.

(*c*) King George V. Docks were opened in 1921 and are now considered the most modern docks of the port. They are concerned with meat, grain and tobacco.

*Tilbury Docks.*These are not shown on Figure 52 but are indicated on that of the riverside industries (Figure 51) because they are further downstream. Railways distribute much of the cargoes of butter, fruit, copra and rice, although barge traffic still takes a lot of goods to up-river factories and warehouses. These docks can accommodate the largest ships and many England-bound passengers land here. For purposes of ship repairs, Tilbury has the largest dry or graving dock of the ten operated by the Port of London Authority.

The following list gives an idea of the great variety of commodities which pass through the dock systems of London:

Imports: Apples, carpets, fruit and vegetables, grain, meat (frozen and chilled), metals, oranges, paper, millboards and pulp, petroleum. provisions, sugar, rubber, tallow, oils (other than petroleum) and wax, tea, tobacco, wines and spirits, brandy and rum, wood and wool.

Exports: Beer, spirits, biscuits, printed books, cement, chemicals, drugs, dyes and colours, confectionery, cutlery hardware, implements, instruments, electrical goods and apparatus, iron and steel manufactures, leather, leather manufactures (including footwear), machinery and parts, jam, fruit jellies, paper, cardboard, etc., parcel post, pictures and prints, piece goods, stationery, refined sugar, and vehicles.

Farming in south-east England—London's food supply. In examining Figure 53 certain general but important aspects of London's food supply come to mind:

1. As in all great cities there are several major sources of supply. These are (*a*) the local areas, within a radius of up to 50 miles; (*b*) other parts of Britain; (*c*) western Europe; (*d*) overseas countries.

2. About two-thirds of London's food comes from outside suppliers.

(*a*) Wheat and meat are imported from other countries, e.g. Canada (wheat), Australia and New Zealand (mutton) and Argentina (meat).

(*b*) Breakfast foods come from nearby continental farmers in Denmark (bacon and eggs), Holland and North France (butter and cheese).

(*c*) Fruit is brought in large quantities from overseas, e.g. oranges from Mediterranean countries and bananas from the West Indies.

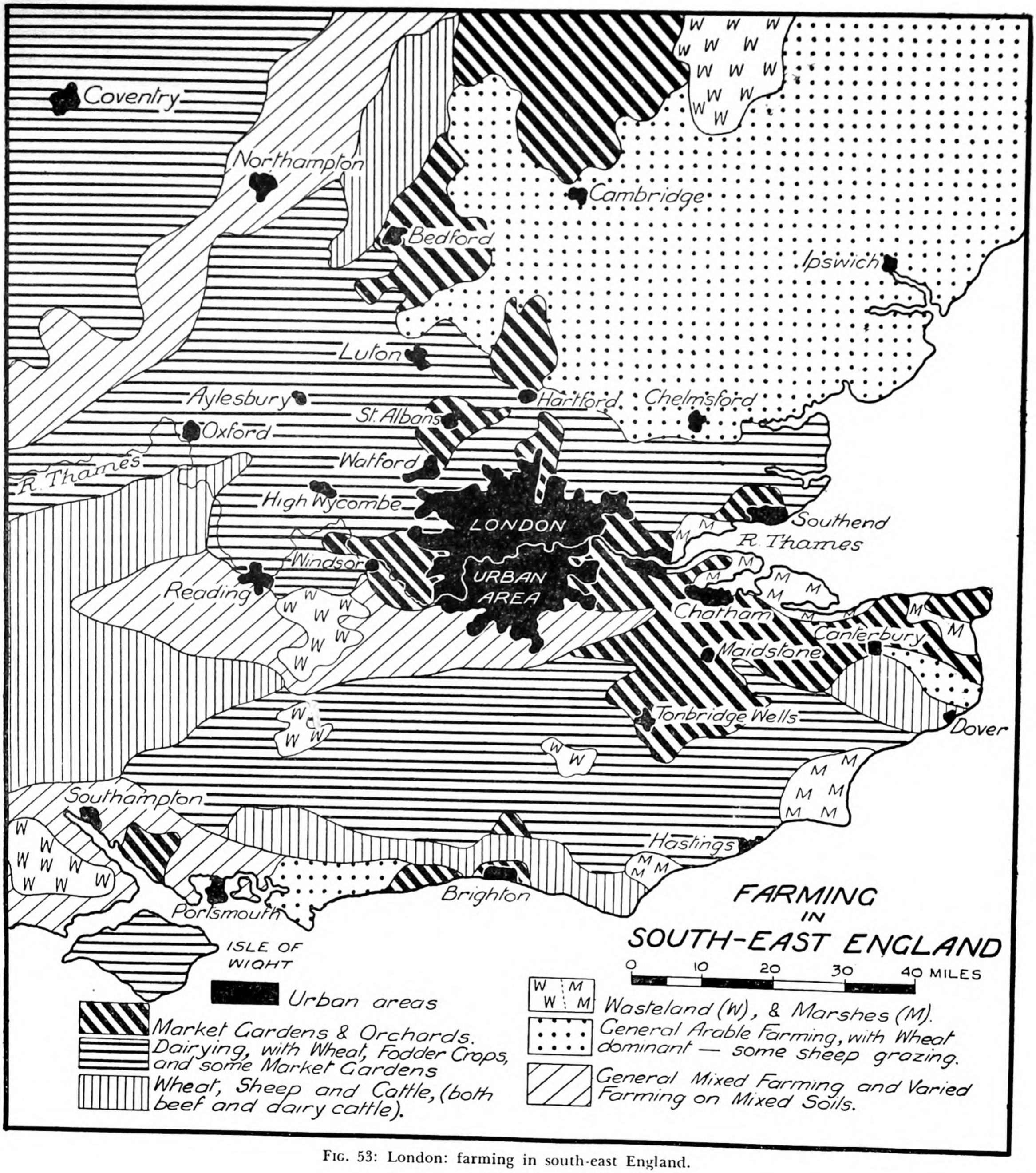
(*d*) Fish provide a contrast by being one of the largest products of the British Isles, and special fast trains bring big amounts from such ports as Grimsby and Hull.

(*e*) Fresh milk, too, is a local production, being brought in from a radius of about 50 miles; at the same time supplementary supplies come from as far afield as the Scottish border.

3. Transport, handling, processing and marketing of foods form one of London's staple industries. These activities are mapped in Figure 50, and discussed in the accompanying text. A unique localisation of market centres has grown up in London itself, and this affords informative comparisons and contrasts with areas and methods in other cities like New York and Sydney. Instead of one large market centre, specialised selling points have developed over the years to meet London's size and needs. Some of these are world-famous.

(*a*) Billingsgate, near London Bridge, disposes of hundreds of tons of fish daily by means of sellers known as fish porters.

(*b*) Covent Garden has always been the market for vegetables, fruit and flowers, although it is now so confined by narrow streets and other businesses that



FARMING IN SOUTH-EAST ENGLAND

FIG. 53: London: farming in south-east England.

its activities have spread into adjacent neighbourhoods. These features and the problems of transport have resulted in the opening of other centres dealing in these products at Spitalfields, King's Cross and Stratford Markets, where they are close to the trains bringing in the special produce trucks.

(*c*) Leadenhall, a poultry-selling market, is not far from Billingsgate.

(*d*) Smithfield receives wholesale meats from the docks for daily disposal to London butchers.

(*e*) Islington specialises in the sale of livestock and has a close association with railway yards which handle them.

Figure 53 also shows that there is a considerable variety in the types of agriculture practised.

1. In general the types of farming have a fairly close relationship to the soil types derived from the rocks as illustrated in the map of general geology (Figure 47).

2. There is comparatively little land which is classified as unproductive, i.e. wasteland and marshland.

3. Stimulus to production is given by the presence of a number of urban markets other than those of London itself.

4. The daily supply to big populations would require special transport operations both by road and rail.

Taking each area in turn we note:

Market gardens and orchards. Considerable areas of these intensively cultivated lands are to be found in inner and outer zones, e.g. in the lower Thames silts and the lands north of Cambridge, near which are some of the best potato fields of England. In both cases drainage has been used extensively to reclaim the soils. As in the case of the Sydney plain, small pockets of reasonably good soils are treated with fertilisers and farmed in an intensive way to take full advantage of proximity to markets, hence the rather sporadic nature of their distribution here. Flowers also figure in this type of utilisation, and some types even come to the London markets from as far away as Cornwall.

Dairying, wheat, fodder-crops and market gardens. This is the most widespread type of agriculture mapped in Figure 53 and is characteristic of the clay lands of the Weald (centre of fruit- and hop-growing as well) and the northern sections of the London basin extending through to the Chilterns.

Wheat, sheep and cattle. These are produced chiefly on the drier upland pastures of the chalk Downs and range from those in the south to Hampshire.

Wastelands and marshes. Such unproductive areas include the swampy sections of the lower Thames and the Fenlands to the north as well as the poorer uplands of the South Downs.

General arable farming. Most of these farmlands are located in East Anglia, the best wheat-growing part of England. Oats, sugar-beet and market gardens specialising in vegetable- and bulb-growing are other types of activities. Sheep are reared on the higher parts.

General mixed farming. This includes portion of the upper Thames clays and sands about Reading, and the Cotswold limestone. In the latter most cultivation (wheat, barley and root crops), and cattle raising is in the lower sections, where the clays give rise to better soils.

THE HUNTER RIVER VALLEY

Physical features and town location. The Hunter River valley is almost a self-contained region with a considerable integration of human occupational activities. To understand how the exploitation of the natural resources there produced such a stage of development, we must survey its major physical features.

1. The valley itself is the largest area of lowland along the eastern coast of New South Wales. Scale reference to Figure 54 will show that it penetrates portion of the highlands for a distance of about 160 miles and averages 75 miles in width.

2. Except for the coastal break at Newcastle and the low altitude of the Cassilis geocol or gap to the west, it is bounded by uplands ranging from 1500 to over 4,000 feet. The ranges shown are actually marginal to large plateau areas, i.e. the Blue Mountains to the south and the New England Plateau to the north.

3. Extensions from both the northern and southern uplands are especially obvious in the eastern section of the valley and serve to divide the smaller lowlying area of the lower Hunter from the 7,000 square miles of hill and valley country which widens out to the north-west and west.

4. It is within the basin limited by these topographic boundaries that the Hunter has developed the most extensive drainage system of the coastal littoral, reaching further to the west than any other coastal

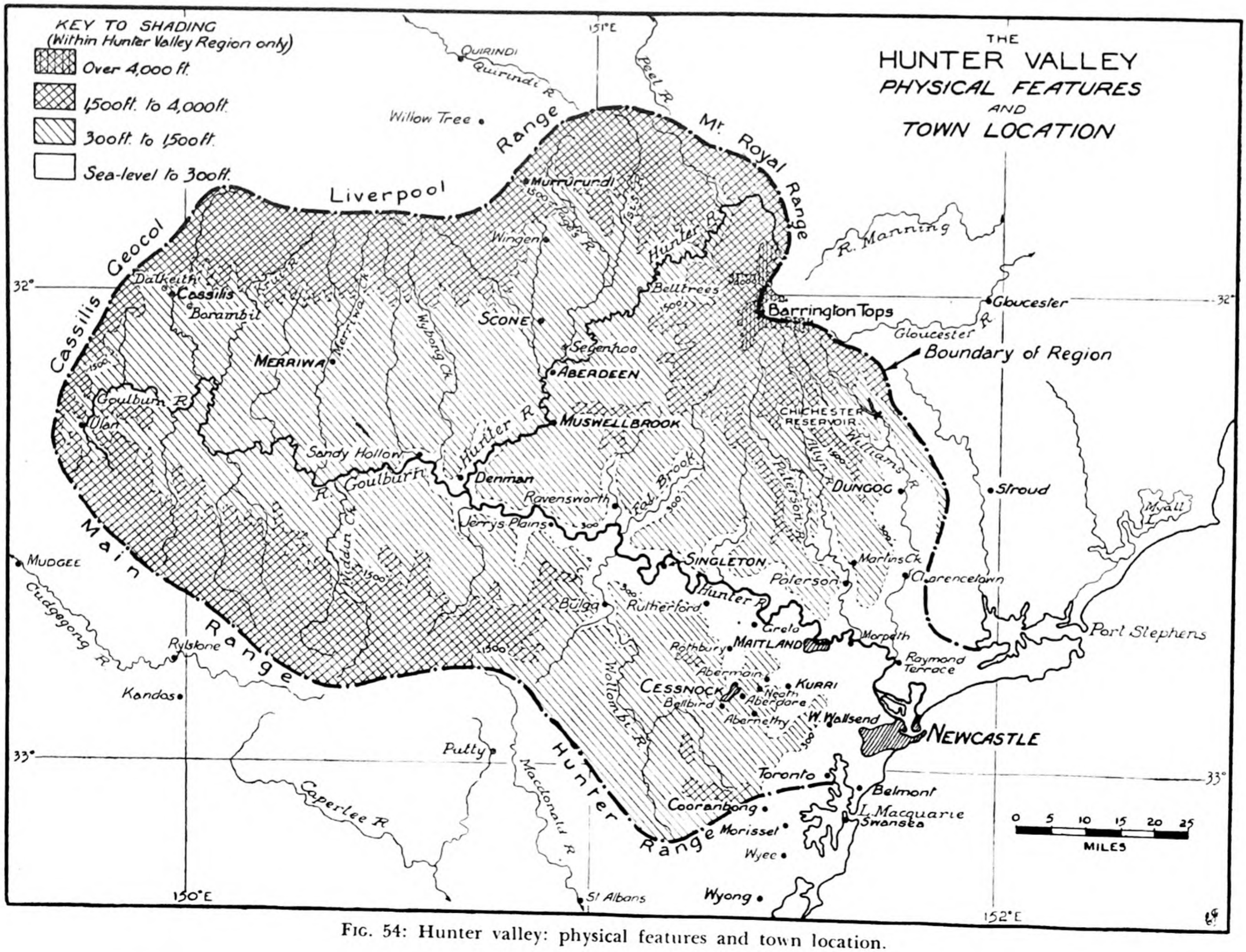


FIG. 54: Hunter valley: physical features and town location.

stream. Important geographic features of this river pattern are:

(*a*) A main stream running roughly south-east, the upper reaches being known as the Goulburn River. The Hunter itself flows in from the north-east near Denman.

(*b*) A series of tributaries flowing from the north and the south on both sides of the valley. The most important of these are the Williams, Paterson and Wollombi.

(*c*) A great number of the tributaries draining the northern than the southern areas of the basin, with the greatest volume of water coming from the north-east. As Figure 54 shows, this produces a lop-sided system of drainage throughout the valley.

(*d*) The watersheds between the streams vary from mature hilly to young rugged mountain country. The many short, steep courses result in active fluvial erosion.

(*e*) Floods occur from time to time because of the drainage pattern and the swift movement of water from the mountain and hilly country of the upper and middle reaches.

(*f*) Flood damage is accentuated by reason of the fact that in its lower course, from Singleton to Maitland, the Hunter meanders considerably over flat valley floors before discharging into a tidal estuary.

(g) The main Hunter stream has little importance for navigation, although many years ago Morpeth was a terminal port and actually more important than Newcastle. Today few ships ply there, and because of siltation, the river is little more than a large creek at less than 40 miles from the coast.

5. The surrounding uplands are also watersheds for a number of coastal and inland rivers, the Manning, Peel, Cudegong, Capertee and Macdonald, whilst the Cassilis gateway is the main divide between east and west drainage.

6. About three-fifths of the whole basin contains land exceeding a slope of about one in six. Land of such a degree of slope is virtually useless for agricultural and industrial purposes but it has a special significance in plans for conservation of water and soil within the valley (see Figure 62).

7. There is a marked grouping of settlement in the lower sections of the valley as against the scattered pattern of the upper areas.

8. The relative importance of the various townships is indicated in part by the type of printing used on the map.

Figure 54 should be used as a basis for reference in subsequent study of the remainder of the Hunter valley series.

Major landforms. The Hunter valley is a mature valley forming a break in the Eastern Highlands and lying between plateau regions in the south and plateau and mountain regions in the north. To the east it has a low coastal foreshore and estuary and to the west a series of low ranges forming the Cassilis geocol.

Within these boundaries there is considerable diversity of landforms, their respective types and locations being set out in the key to Figure 55 and in the map itself. By way of explanation, the following geographical comments are added.

Mountainous country. The mountain lands rise above 4,000 feet and are known as the Mt Royal Range, with its southern extension, the Barrington Tops. Because of step faulting (on the southern face of the Barrington Tops) and severe dissection by the headwaters of the Hunter and its tributaries, they are extremely rugged areas. They provide a watershed between the Upper Hunter and its major branches of the Williams and Paterson rivers. The slopes are steep and heavily forested, but past erosion of patches of basaltic capping has taken place to provide rich alluvium in the lower courses of the streams.

Hilly country. This is comprised mainly of foothills which are extensions of the mountain lands. The more rugged sections include the Liverpool Ranges, but the long watershed spurs into the valley become progressively less steep, especially where the narrow valley plains begin to broaden, e.g. the Pages River. At one stage these were heavily timbered, but much was cleared for grazing lands. On such slopes this subsequently led to serious erosion of what were already rather poor loamy soil types derived mainly from claystones, mudstones, shale and limestone.

Foothill slopes. These are a continuation of the hilly lands, and merge into narrow valley plains with some restricted areas of river flats. Here again clearing and farming have given rise to serious erosion problems with soils which are mostly shales and clays on the slopes. Attention is drawn to one interesting section of this particular landform type as it obtains in the upper Goulburn valley. This is the Cassilis col, or saddle, which is the lowest crossing in the whole of the Eastern Highlands. Its commercial possibilities have not yet been explored by the construction of a railway to link the port of Newcastle with the western pastoral districts

Sandstone plateau. This landform extends for almost the entire southern boundary of the valley. As the northern (but lower) limit of the Blue Mountain type of sandstone country, it is largely a wilderness of ridges and deeply dissected canyon type gorges. Soils are light, sandy and porous so that the timber covering is stunted and only limited farming can be attempted along the better parts of the Wollombi. Its major function is that of a catchment area for the northward-flowing tributaries of the Hunter.

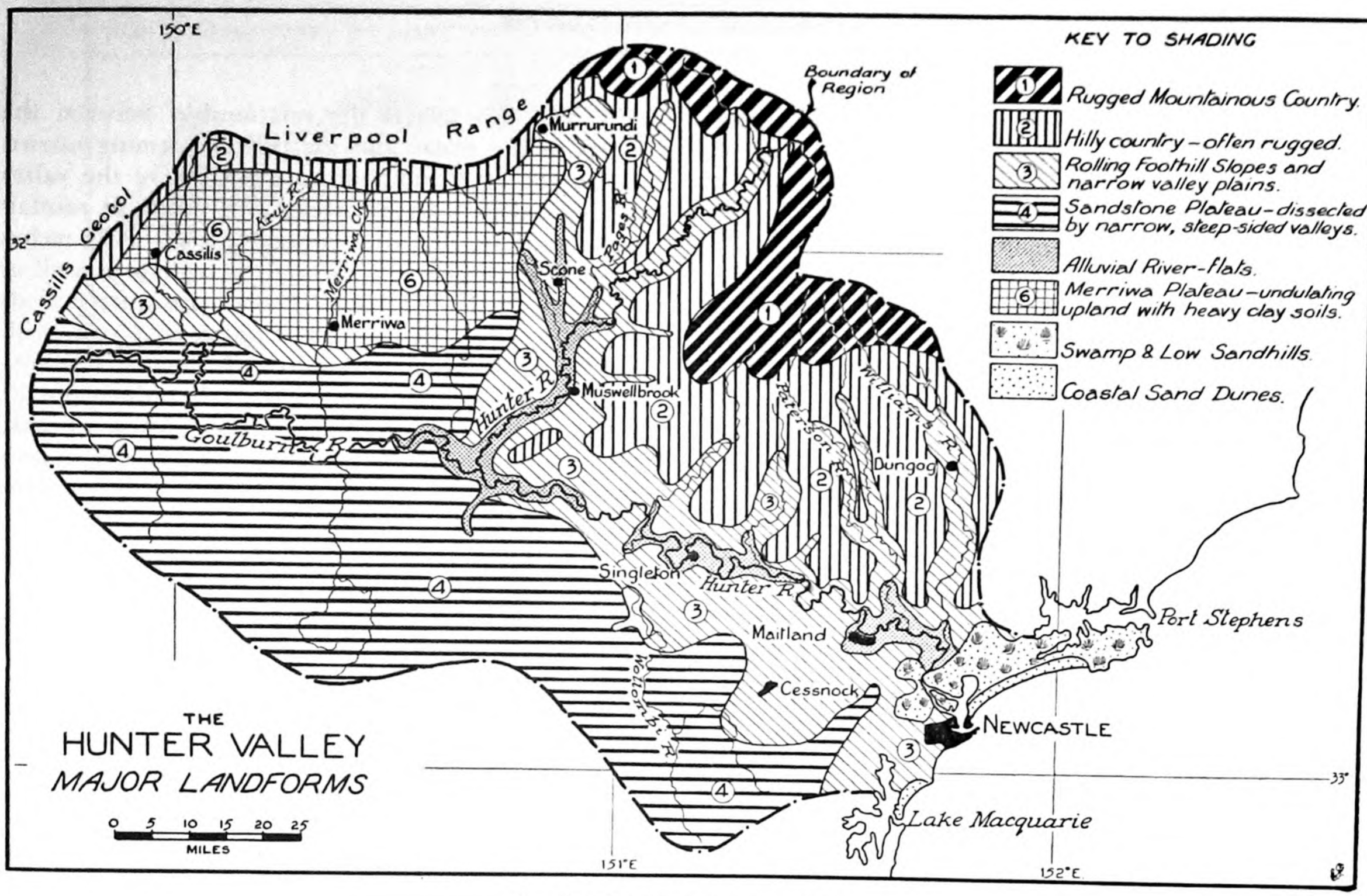


FIG. 55: Hunter valley: landforms.

Merriwa plateau. Situated in the north-western section of the valley, this is a gently undulating upland drained by tributaries of the Goulburn River. It is noted for its heavy black clayey soils of basaltic origin. As a result it has proved rather difficult for arable agriculture like wheat, but has developed into excellent grazing country for sheep.

Alluvial river flats. These flood plains of the Hunter and lower Goulburn are limited in their extent in comparison with the other landform types of the valley. They are the result of past floods laying down rich beds of alluvium derived from the erosion of rocks in the upper reaches of the rivers, e.g. the basalts of the Mt Royal Range. The flats themselves are actually surrounded by land of relatively poor soils. The most extensive and fertile areas are located between Raymond Terrace and Maitland, for it is here that silts have accumulated from no less than three streams. The soils have been farmed for dairying, fodder and vegetable crops, but more intensive agriculture is possible. At the moment lack of planned irrigation, uncontrolled flood waters and extensive river bank erosion are threatening many parts.

Swamps and sandhills. Such features are characteristic of the lower estuarine course of the Hunter and the adjacent coastline, and they rarely rise above 25 feet in height. Such areas as have been reclaimed are used for building sites as in Newcastle itself, or for vegetable-growing as at Port Stephens. Perhaps the most important asset of these landforms is the Tomago sand beds between Newcastle and Port Stephens, from which important subterranean water supplies are drawn. Extensive supplies of ground water exist throughout the valley beneath the river flats. These have been explored already as a supplementary form of irrigation.

Average annual rainfall. Figure 56 is of special importance because when studied together with that of landforms (Figure 55) it helps to explain the valley's present pattern of agricultural activities and some of the major problems associated with it. Significant geographical aspects of the map are:

1. Rapid decrease of rain westwards, as indicated by the swing of the isohyets from amounts of over 40 inches to those of less than 25 inches within a short distance from the coast.

2. Unequal distribution of rain throughout the valley. Only a small coastal strip receives over 40 inches per year, while a proportionately large area of the centre and upper valley has less than 25 inches.

Both the above can be checked by noting the figures for a number of stations shown on the map. Newcastle has an annual rainfall of 44 inches, Maitland 33 inches, Singleton-Cessnock 27 inches, and the upper valley around Merriwa 22 inches.

3. With respect to season of rainfall, records reveal that it is uniform throughout the year, with no dominant season. On the other hand there are periods of no rain, and this affects the relationship between the places in the valley and the type of farming carried on. In the Maitland-Newcastle portion of the valley the normal is to have at least two inches of rainfall each month, so that with respective totals of 33 inches and 44 inches per year the rain is regular as well as plentiful. In the Singleton-Cessnock area, dry periods may range from two to four months each year, with less than two inches falling in each month. The situation is even more marked in the valley above Singleton where in centres like Denman, Muswellbrook, Scone, Cassilis and Merriwa, farmers usually experience five to seven months in the year with less than two inches of rainfall a month.

4. Arising from the above is the general conclusion that a large part of the valley is too dry for extensive agriculture. This explains why so much of it is taken up with grazing activities and why also a good deal of the better river flat land has not been taken up. It is closely linked with the present plans for water conservation, of which irrigation is one of the main features.

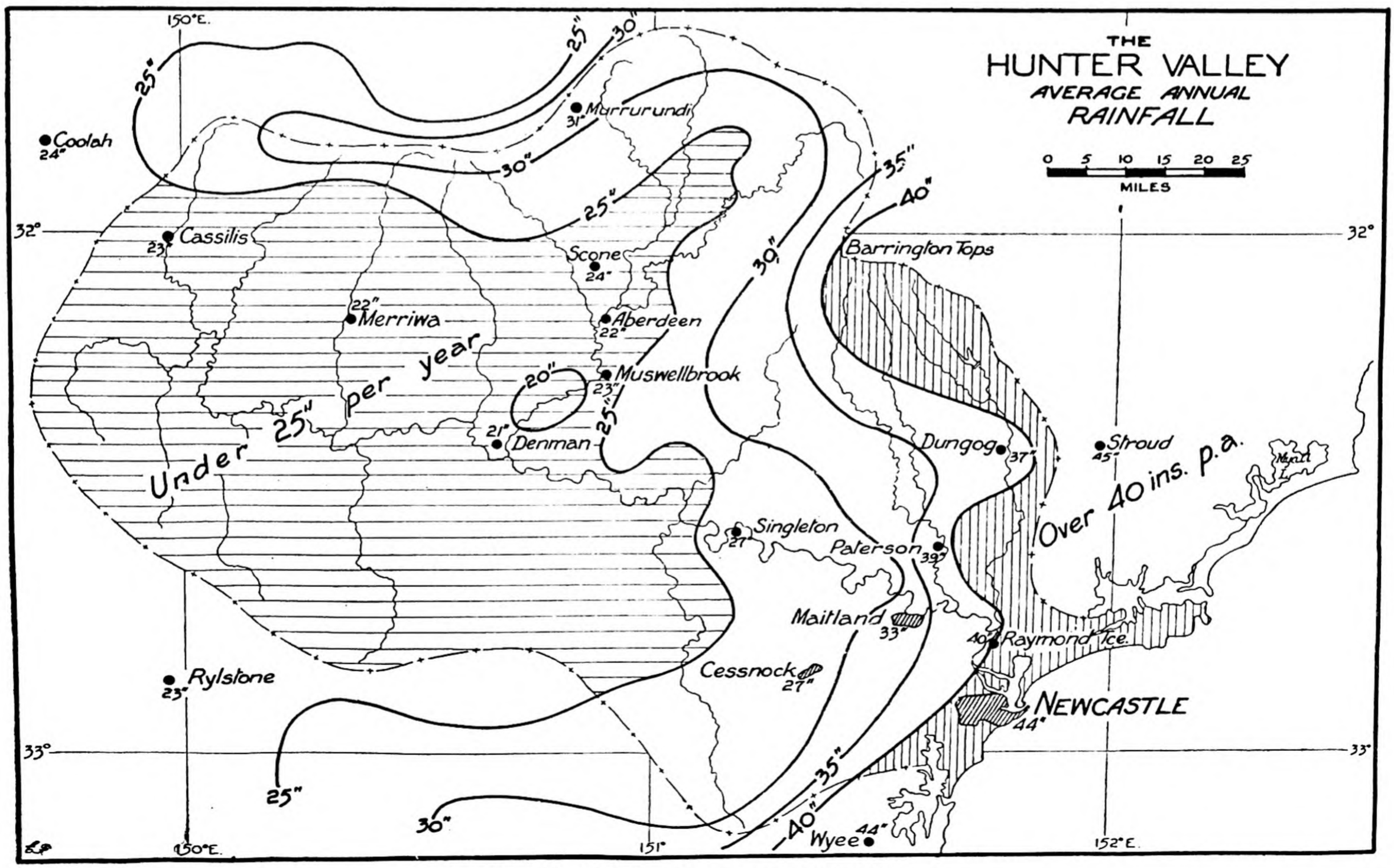


FIG. 56: Hunter valley: annual rainfall.

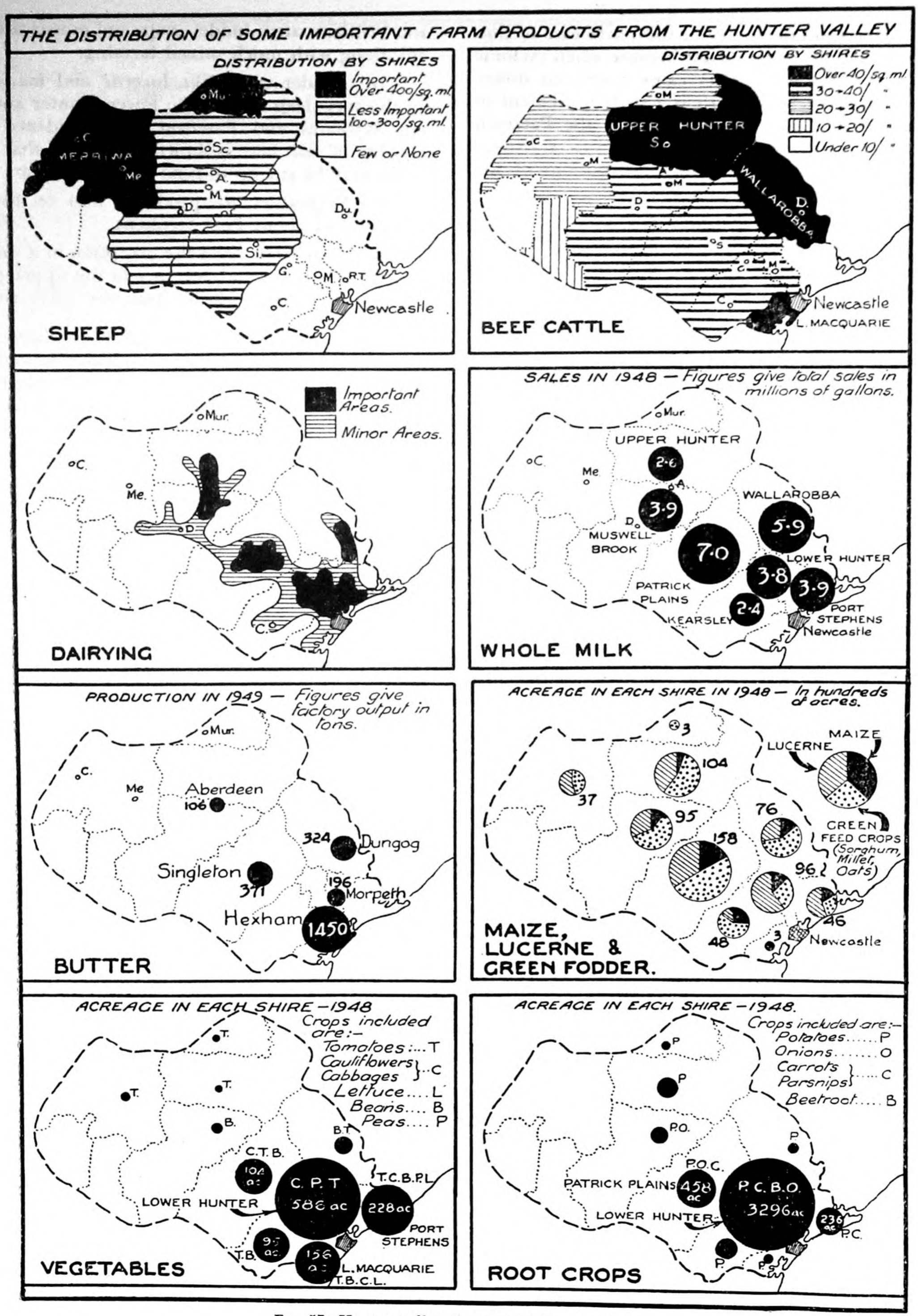


FIG. 57: Hunter valley: important farm products.

5. Heavier rainfall occurs in the north-east section of the valley. This is significant because when cyclonic storms sweep the valley they cause torrential downpours in this area. The result is a swift movement of water along the short steep courses of the Paterson and Williams to help swell the flood waters already proceeding eastwards from the contributions of the upper Hunter, Goulburn and Wollombi.

Heavier falls on the marginal portions of the valley, where the degree of slope is high and run-off quick, account in part for the presence of considerable quantities of ground water at lower levels, e.g. the river flats and flood plains.

Farm products from the Hunter valley. The patterns of distribution from farm products shown in Figure 57 here have been determined by several factors, e.g. landforms, soils and rainfall. Reference should be made to these frequently, and care taken to check the names of the main settlements as set out in the various shires. The facts concerned with the geography of Hunter valley croplands are set out below to help towards a better appreciation of the pattern of regional activities to be discussed later (see Figure 60).

General aspects of map series. (*a*) Sheep grazing activities are found in their greatest intensity in the western and north-western areas of upland and hilly country, e.g. Merriwa. Note that the density is over 400 to the square mile.

(*b*) Beef cattle are raised in considerable numbers in the valley, but attain highest production in the hilly rugged lands of the north and north-east, where they average over 40 to the square mile. Horses, too, are plentiful in the upper Hunter.

(*c*) Dairy farming is confined almost entirely to the river valleys, more especially the alluvial flats of the upper, middle and lower Hunter, and the Paterson-Williams area; fodder crops and grasses are plentiful along with much mixed farming.

(*d*) Fodder crops like lucerne and maize thrive in the very deep soils of the lower Hunter and adjacent Williams and Paterson flats. Evidence of the fertility of soils here is shown by the fact that lucerne crops may be cut up to nine times each year.

(*e*) Vegetables are produced also on the lower Hunter and about Port Stephens.

(*f*) Root crops, with the exception of a small production of onions and potatoes in the upper portions of the valley, come wholly from the lower river.

Some details of production. (*a*) With dairying very important in the area it is not difficult to understand that 35 per cent of Sydney's whole milk supply comes from the middle and lower valley. Apart from that, considerable quantities are distributed locally and processed into butter, cheese and powder.

(*b*) Butter is produced at several co-operative factories. That at Hexham is one of the largest in New South Wales. Considerable quantities are exported, along with powdered milk, which is not important locally because of the large consumption of whole milk. Cheese is also made for the Australian market.

(*c*) The growing of maize, lucerne and green fodder crops is closely linked with the heavy demand for fodder by local dairymen who also rear pigs. The proportion of these crops that does move out goes to city dairy herds and sheep in the western districts.

(*d*) There is a considerable variety in vegetables; but the main types are cauliflower, cabbage, onions and tomatoes, almost exclusively from the Maitland flats. Markets are found in Sydney as well as nearby Newcastle.

(*e*) Fruits and vine crops are shown on Figure 60.

Coal mining in the lower Hunter Valley

Coal exists throughout the Hunter valley under the river beds, widening out at the coast to the area between Port Stephens and Lake Macquarie. Although the deposits are worked in the middle reaches about Muswellbrook, the most important ones are those shown on Figure 58. Actually their location can be described as that of the northern rim of a coal-bearing area shaped like a huge saucer. This dips south, 3,000 feet under Sydney, rising to the Shoalhaven River and west under the Blue Mountains. Within this saucer there are two distinct seams of coal, an upper and a lower one, and they can only be worked where they outcrop suitably. Thus the upper seams are mined in the Illawarra district (the Shoalhaven seams have not yet been mined), Lithgow and around Newcastle. The lower measures are worked in the Maitland district on the Cessnock-Greta field (see Figure 59).

The foregoing helps to explain why there are two distinct mining districts making up what are called the Northern district coalfields, drawn on the map:

1. The Newcastle district collieries, some 10 to 15 miles from Newcastle itself, producing coal from what is called the Borehole seam and so labelled Borehole coal. From this seam, averaging about six feet in thickness, there comes an annual output of about three million tons. This is the coal from which blast furn-

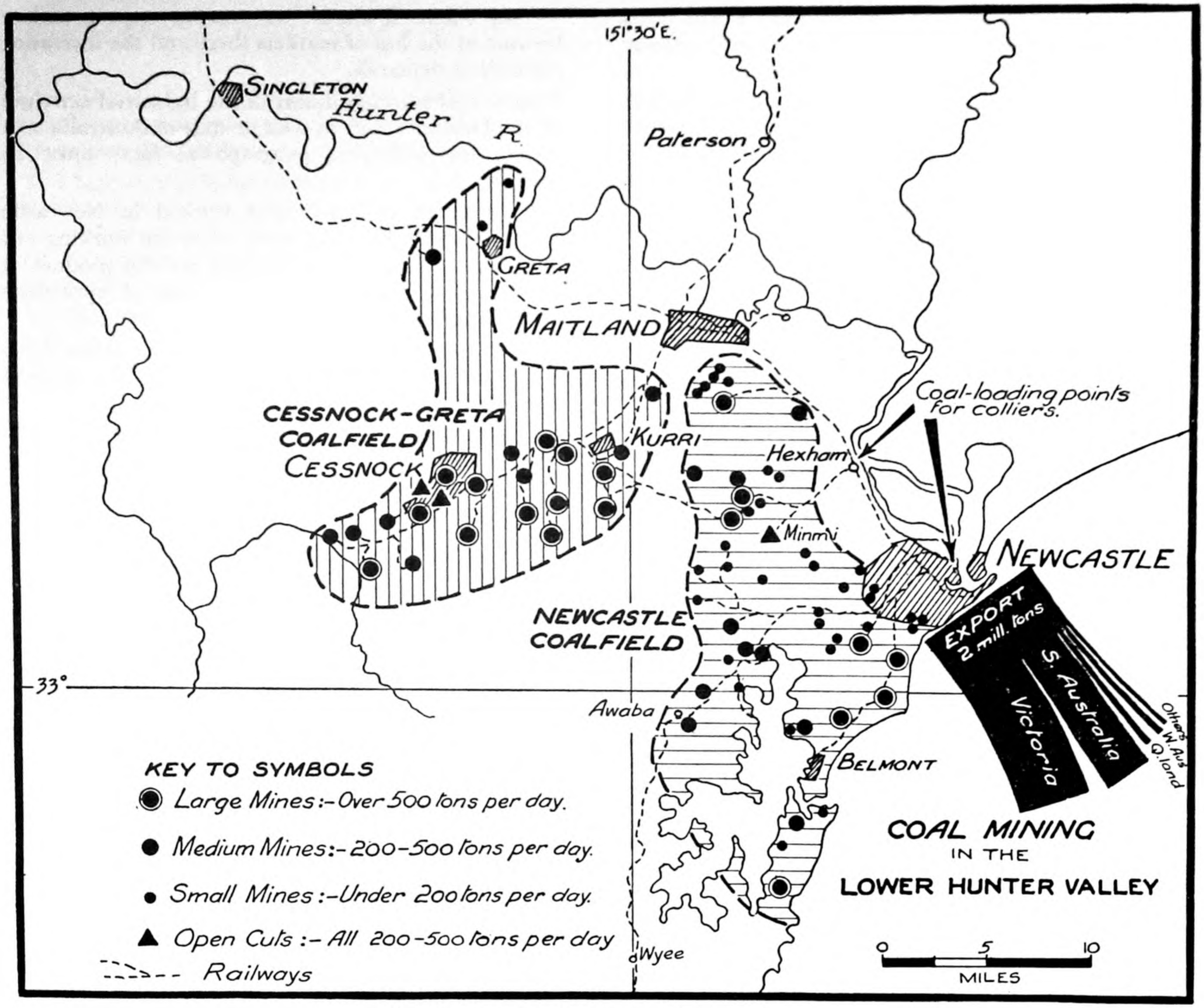


FIG. 58: Hunter valley: coal-mining and export.

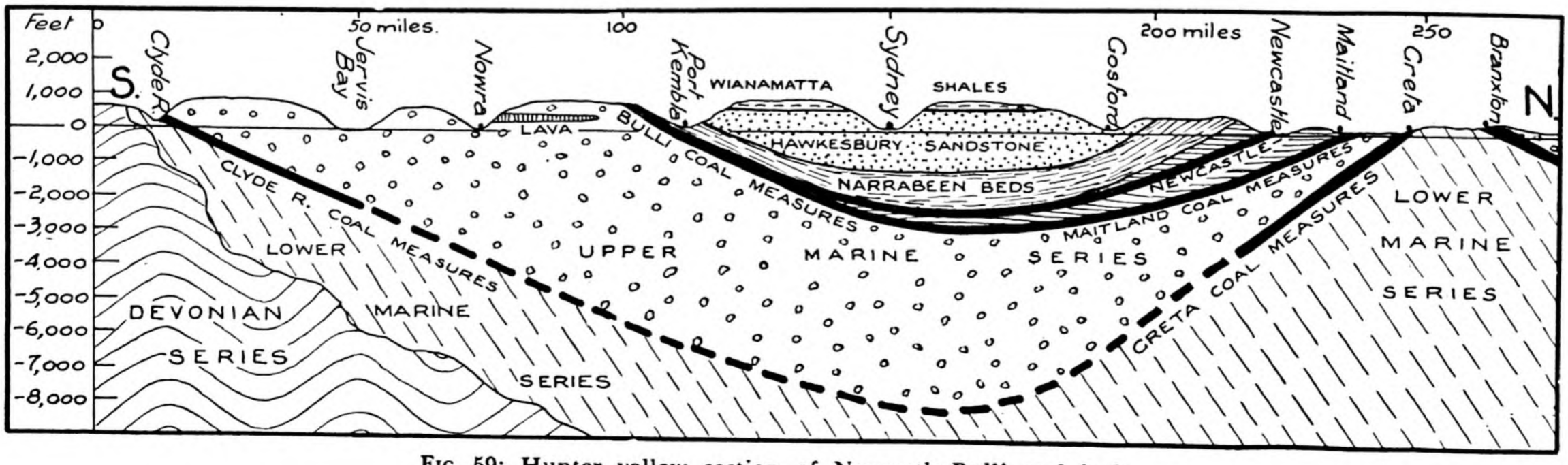


FIG. 59: Hunter valley: section of Newcastle-Bulli coal beds.

ace coke is made for the adjacent steel works. It is also a high-grade steam coal used by factories, power houses, engineering plants and shipping.

2. The Cessnock-Greta coalfield (Maitland district). The collieries here are located between 25 and 45 miles from Newcastle, and from the Greta seam, as it is known (ranging in thickness from six to 34 feet), they mine about five million tons of coal each year. This is more than 60 per cent of all the coal produced in the Northern districts. It is regarded as being among the best gas-making coal in the world and so is used extensively for that purpose by gas companies. It is also used in factories and homes in several of the urban areas of Australia.

Further relevant data on these two fields has been plotted on the map and comments are added here for purposes of explanation.

(*a*) The relative size of the collieries shows that the larger ones predominate in the Cessnock-Greta area, the one of greatest production.

(*b*) The respective production of the various types of mines includes that of the open-cuts. Some small mines still operate within the urban area of Greater Newcastle, but the output of this "Tomago" coal is small.

(*c*) The railway pattern of private and government lines indicates a concentration on the two major loading points for colliers, i.e. Hexham, with a plant for loading coal into special ships for Sydney gasworks, and the Dyke in Newcastle port. Here there is government ownership of equipment for this work of loading intrastate, interstate and overseas ships and bunkers.

(*d*) The amount exported and its destination reveal interesting facts concerning the use of the coal from here by other States. Queensland, with a relatively good production from its own fields, takes little; but Victoria, in spite of large brown coal deposits, must buy a great deal to supply its needs for steam and gas.

(*e*) There is almost no overseas export, mainly because of the loss of markets there and the increasing Australian demands.

Since coal is so significant in the industrial activities of the Hunter valley as well as that of Australia as a whole, the following geographical facts must be stressed:

1. Although coal was first worked in Newcastle itself, over the past fifty years or so the working out of this and the growing demands for the product of the Cessnock fields led to the centre of operations being moved to the latter area.

2. The Hunter valley deposits contain about 4,700 million tons of coal, i.e. one-third of all the reserves of Australia.

3. Almost all mines are privately owned and Caledonian Collieries is one of the largest organisations of its kind in the southern hemisphere. The Broken Hill Proprietary Company operates several mines because its steel works absorb some 30,000 tons of coal each week.

4. There have been many important developments in the industry in recent years, e.g.

(*a*) the establishment by the New South Wales and Federal Governments of a Joint Coal Board as an authority for the purpose of re-organising and rehabilitating the coal industry by stepping up production, improving conditions of miners, and providing housing, educational, recreational and other facilities;

(*b*) the growing use of mechanisation and experiments in newer methods of mining;

(*c*) increased research into problems such as dust and mine rescue work.

5. Coal is the foundation of the Hunter valley's industrial development. It encouraged the foundation of the steel industry, which in turn attracted many subsidiary industries. The result is that today a major sub-region now occupies the lower valley, which has four-fifths of the total population.

Figure 60 and its explanatory key provide several general aspects of geographic interest which precede a more detailed analysis of each sub-region.

1. There is a striking contrast between the various activities of the valley, ranging as they do over a wide variety of occupations associated with mining, industrial processing, transport and arable and pastoral agriculture.

2. There are marked contrasts between the patterns of the upper and lower portions of the valley, both in regard to the nature and the areal spread of the activities shown, e.g. the upper parts are mainly concerned with pastoral and rather extensive forms of agriculture, whereas the lower areas are taken up with intensive farming and secondary industry; and there is only a loose integration between these two.

3. Land occupance is most intensive and highly integrated in the lower valley because of the presence of a dense population engaged in many occupations which by their nature call for interdependence.

4. A considerable amount of the valley is still practically uninhabited and not capable of much use beyond timber getting.

Profitable comparisons and contrasts can be made between the character, spread and integration of activities here and in Lancashire (see Figure 67).

The sub-regions. 1. Seaport, manufacturing centre and general regional focus:

(*a*) *Seaport.* Newcastle as the coastal outlet for the Hunter valley is situated on a navigable estuary where a man-made port was constructed by constant dredging, reclamation and the laying down of breakwaters. It has good accommodation for interstate and overseas vessels and its harbour facilities include large wheat silos, wool stores, and wharves and railway marshalling yards for the handling of coal exports. Government dockyards build and repair ships, and steel works import large quantities of raw materials and export fabricated goods. As well as the specialised activities there is a considerable import of general merchandise.

(*b*) *Manufacturing centre.* Manufacturing activities are concerned primarily with iron- and steel-smelting and treatment industries. These include many minor types of plants as well, together with railway and fabricating warkshops. The city also has many manufacturing units for providing clothing, foodstuffs and furniture. Rail, road, water and bus transport handles the movement of all the necessary raw materials as well as the workers employed.

(*c*) *General regional focus.* Some comment has already been made upon the general pattern of the many sub-regional groups within the major regional boundary of the Hunter valley, e.g. mining, pastoral and arable agriculture, manufactures and commercial activities. There is integration between all these, and one of the main factors responsible for this is their dependence upon the port and city functions of Newcastle. The dairy produce is used locally and in Newcastle as well as in Sydney. Coal from the mines either passes to the port for export or is used in the Newcastle factories. Wool from the upper valley is largely sold in, and shipped from, Newcastle. Beef cattle are killed at, and the carcasses frozen in, the abattoirs at Aberdeen and Newcastle. Timber from the adjoining hills is used in the mines for pit-props or sent to the timber yards at Newcastle for further treatment. The function of the city as a regional focus is also emphasised by its transport links throughout the valley by road and rail, while at the same time there are land, sea and air links with other parts of the State. With the completion of a rail line through the Cassilis gap there will be important connection with the pastoral regions of the middle west. In order to cope with the many interests arising from its functions as a regional focus Newcastle has an interesting pattern of city core, commercial, administrative, residential, and open space areas (see Figure 61).

2. Coal-mining areas. This sub-region is closely connected with Newcastle. As well as the population of miners and mine workers there are considerable numbers of agriculturalists growing fruit and vegetables as well as a number of poultry farmers who occupy portions of the upland areas south and west of the Newcastle sub-region. Important settlements are those of Cessnock, Greta and Kurri Kurri. Notice also the area near Muswellbrook, where the principal open-cut mine in the State is worked.

3. Holiday and recreation areas. These include the coastal centres of Lake Macquarie and Port Stephens. They provide a variety of recreation activities for people of the valley but more particularly the industrial and mining population. Many tourists and holiday-makers from other parts of the State also come here. In the Port Stephens district there is some truck farming in vegetables, and tomatoes. In the better parts dairying is possible. About both places there is a thriving fishing industry.

4. Intensive farming. Some important details of the main industries of dairying, vegetable and fodder crop growing have been given in Figure 57. Here the plotting of their general regional incidence shows how they are confined to the immediate river plains and adjacent low hills of the Hunter and Williams Rivers with an extension to Port Stephens. To gain a clearer

idea from this sub-region of their actual development some examples have been selected for study.

(*a*) *Upper Hunter district.* The townships of Scone and Muswellbrook are centres for mixed farming devoted to hay crops, wheat (on hills) and lucerne (by irrigation). Dairying supplies factories in both settlements. The larger one at Muswellbrook also makes cheese and powdered milk, and as a co-operative, stores fertilisers and farming equipment. A subsidiary industry is the treatment and freezing of rabbits, meats and poultry. Aberdeen has the largest refrigeration plant, chilling meat and beef for Australian and world markets. The most important dairying district of the middle and upper Hunter is around Singleton, which is the main market town. Mixed farm products here include fodders, maize, lucerne, vegetables, stone and citrus fruits.

(*b*) *Middle Hunter district.* This is an area of most intensive agriculture, with its farm lands producing vegetables, lucerne and fodders, fruits and millet. The animal industries include dairying (butter, cheese, and milk for Sydney and Newcastle) poultry and pig raising. Maitland is the hub of the district and its market for the sale of horses and cattle is one of the largest in Australia. Bricks, tiles, pottery, clothing and furnishings are also produced. In addition it is a mining community and a commercial and educational centre.

(*c*) *Lower Hunter district.* There is considerable contrast in land utilisation here, for part of it is poor country, part the richest in the State. Mixed farming (fodder and vegetables) characterises the junction of the Hunter and Williams rivers, where the township of Raymond Terrace has two factories, one handling dairying foods and the other producing enormous quantities of masonite boards for building purposes.

(*d*) *Paterson-Williams district.* Agriculture here is similar to that of the Lower Hunter but with more attention given to the growing of maize and the raising of pigs. It is one of the best-known citrus fruit districts in the valley. Dungog on the main North Coast rail line sends pasteurised milk in bulk to Sydney and manufactures casein for the later production of buttons, handles, etc.

5. Grapes and wine. The main grape- and wine-producing district of the valley is on an area of soils derived from volcanic rocks, fringing the coalfields near Cessnock. Although both fruit and wines reached a high standard at one stage, the industry suffered

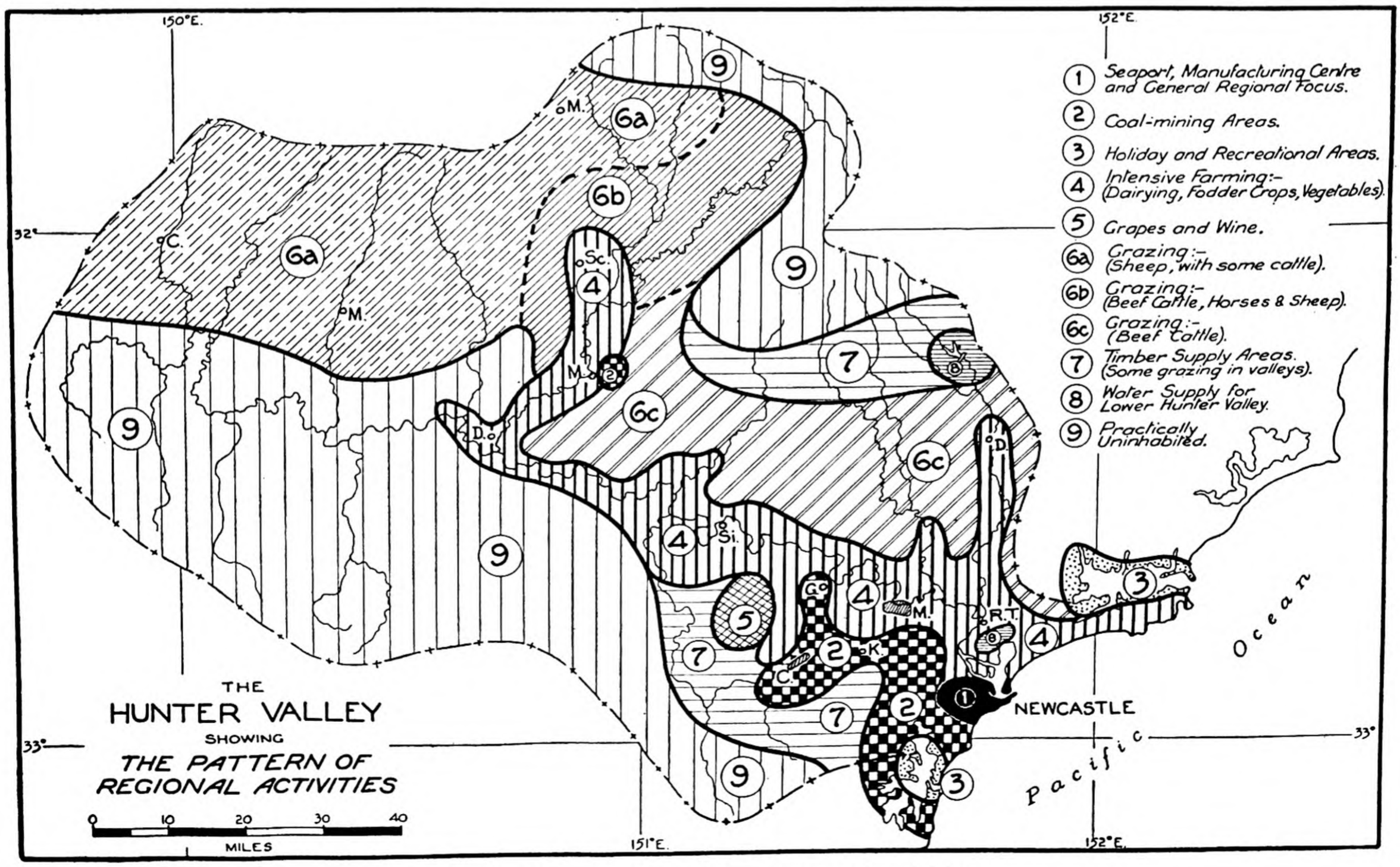


Fig. 60: Hunter valley: pattern of regional activities.

reversals and for some years viticulture was at a standstill. Of recent years the earlier centres, as at Rothbury and Pokolbin, have been replanted and extended, so that now a big proportion of the 2,000 acres of vineyards under cultivation in the lower Hunter are thriving. With the interest of several well-known wine firms, the industry should progress.

6. Grazing. (*a*) *Sheep with some cattle.* Figure 60 shows that this pastoral activity is the major agricultural interest of the Merriwa Plateau area. It occupies a large part of the western section of the region, with hilly uplands, rainfall under 25 inches and heavy black soils. This is the area of large sheep- and cattle-stations, from which come some of the best beef and finest wools. The soils are against large-scale growing of wheat, but some is produced for hay about Cassilis. This town and Merriwa are the commercial centres. In the northern section of the sub-region (a portion of the upper Hunter) stands Murrurundi, a road and railway junction town with a special interest in the export of wool and fat lambs.

(*b*) *Beef cattle, horses and sheep.* A pastoral district, this appears as a continuation of the Merriwa district, but the increasing ruggedness of its northern parts results in more emphasis going on beef cattle. These are found mainly about the hills with sheep in the valleys, some of them being raised for mutton. Here again there are large holdings (many are being broken up) with several famous for blood-horse studs. This is due to the presence of soils impregnated with limestone, which is good for bone building. Some of Australia's finest racehorses have been bred on these stations. Scone is actually the main township and has a number of industries other than pastoral, as the river plains support considerable mixed farming.

(*c*) *Beef cattle.* Reference to Figure 55 will show that this sub-region consists of hilly land sloping down to the river plains, the upper sections being rugged. On the east it extends to the divides of the Paterson and Williams rivers, and the Dungog district. Sturdy types of beef cattle thrive on these pasture-lands, and abattoirs and chilling works such as those at Aberdeen handle the meat products.

7. Timber supply areas (some grazing in valleys). Only about 10 per cent of the Hunter valley's timber needs are obtained locally because supplies in previous years came from normal clearings, without replacement. But the State Forestry Commission is attempting to remedy the position by reafforestation and clearing areas of old growth. As it is, the main supplies come from the sub-regions mapped here, the Wollombi district and the headwaters of the Paterson and Williams rivers. Most timbers are hardwoods, used for structural purposes, sleepers and pit props. This gives the southern forests a close connection with the adjacent coalfields and Cessnock has a certain market. There is a considerable export overseas, especially to New Zealand. In the less rugged sections of each of the above districts, cattle-grazing is possible. About Wollombi there is a certain amount of dairying, orcharding and market gardening for the mining population of the nearby towns.

8. Water supply for Lower Hunter Valleys. There are two sources of water supply:

(*a*) the Chichester Dam, 50 miles north of Newcastle, with a capacity of 5,000 million gallons;

(*b*) the Tomago sand beds which have only been tapped in recent years by tube wells operated electrically so as to deliver 25 million gallons daily.

The Hunter River District Board controls these systems and a mixture of water from both is delivered for domestic, industrial and sewerage purposes. The area served embraces Newcastle, Maitland, Cessnock, Raymond Terrace, Branxton and Morisset. The Tomago Sands supply is attracting industry, the huge British firm of Courtaulds erecting a factory for the manufacture of textiles.

9. Practically uninhabited. These sub-regions were noted in the description of the major landform types of the valley, viz. the sandstone ridges and gorges of the southern plateau and the very rugged mountain lands in the north about the Mt Royal Range. Such settlement as does occur is concerned with timber-getting, and cattle-grazing in the valleys.

Location of industrial plants (Figure 61). The location and function of Newcastle's industrial plants can be understood more fully if some important geographical facts are recapitulated in the first place about the harbour itself, which plays such a large part in the economy of this sub-region of the valley.

1. Apart from some surrounding hills, Newcastle is situated on a coastal river plain drained by the Hunter flowing into its tidal estuary.

2. The actual mouth of the river, as shown on the map, has been extended artificially by building breakwaters on the north and south sides of the river outlet. These improve the entrance, which is now 1200 feet wide and provide a 350-feet navigable channel across the bar.

3. The harbour is landlocked enough to make it safe for ships in all weathers. But it is subject to considerable siltation from the upstream waters and as a result several lower river islands have been built up.

4. This means that constant dredging is necessary to keep the channels clear. At the same time basin sites have been developed and wharfage space enlarged by reclamation.

5. Today, the entrance and inner basin cover an area of 162 acres, while the main shipping space is about 570 acres.

6. In addition, use has been made of some of the islands and small tributaries, e.g. Walsh Island and Throsby Creek, for industry and transport.

7. Navigation of the lower reaches of the Hunter from the harbour is only possible as far as Hexham, which is ten miles from the sea. Ships drawing up to 14 feet of water can reach here by working the tides.

Harbour-side industries and facilities. Figure 61 shows a close concentration of the rail pattern on the harbour foreshores because of the types of industries involved and the bulk nature of the goods usually handled by shipping. Such terminals have been seen already to be characteristic of cities, particularly those on tide-water sites, e.g. New York. Port administration is vested in three Government departments: (*a*) the Maritime Services Board, which exercises a general supervision of the harbour, especially of navigation; (*b*) the Department of Public Works, which builds and repairs the wharves other than those privately owned, e.g. the Broken Hill Proprietary Company; (*c*) the Department of Railways, which controls coal shipping, since Newcastle is primarily a coal-loading port.

Proceeding from the harbour mouth and following the foreshores, the following are important features:

The Zara Street power station. Situated at the eastern end of the city this power-house is owned and operated by the Department of Railways. Electricity generated here is distributed not only for the railways but for

(*a*) local domestic and civic purposes;

(*b*) large mining and industrial undertakings in and near the city;

(*c*) distant centres, e.g. West Maitland, Cessnock, Gosford, and Kempsey.

It is also linked with other generating units in Sydney and on the Clarence River, so that power may be interchanged when necessary. Over 4,000 tons of coal are used each week, while enormous quantities of harbour water are absorbed daily for cooling purposes.

Wharves and storage space. An almost continuous series of wharves extends around the harbour, and their pattern forms a contrast with the piers of other ports, e.g. New York, and the dock and lighter system of London. There is a certain localisation due to their function:

(*a*) *General wharves.* These are adjacent to the city core and handle general cargo. There is railway accommodation alongside them and their situation in close proximity to the city eliminates to some extent the need for storage space and storage charges for cargoes which include softgoods, foodstuffs, hardware, wool, frozen meat, butter, etc.

(*b*) *Inflammable liquid wharf.* This is specially built to handle fuels and accommodate overseas tankers.

(*c*) *Silo wharf.* Adapted to the rapid bulk handling of wheat to and from the port's terminal elevators, which can hold a constant shipping reserve of a million bushels.

(*d*) *Cattle wharf.* This is used for the various types of livestock which figure in the animal industries of the valley.

(*e*) *Timber wharf.* Located at Carrington, this wharf is close by the large timber yards, saw mills and joinery works along Throsby Creek.

(*f*) *Basin wharves.* Handling general cargoes with highly mechanised equipment, these include the electric travelling crane wharf (west side), the hydraulic travelling crane wharf (east side), and the sulphide wharf.

(*g*) *Dyke coal wharf.* This was designed specifically for handling coal as fast as any port in the world, both by electric and hydraulic cranes.

(*h*) *Market Street wharves.* These are used mainly in the handling of passenger ferries and small harbour craft.

Government dockyards. Owned and operated by

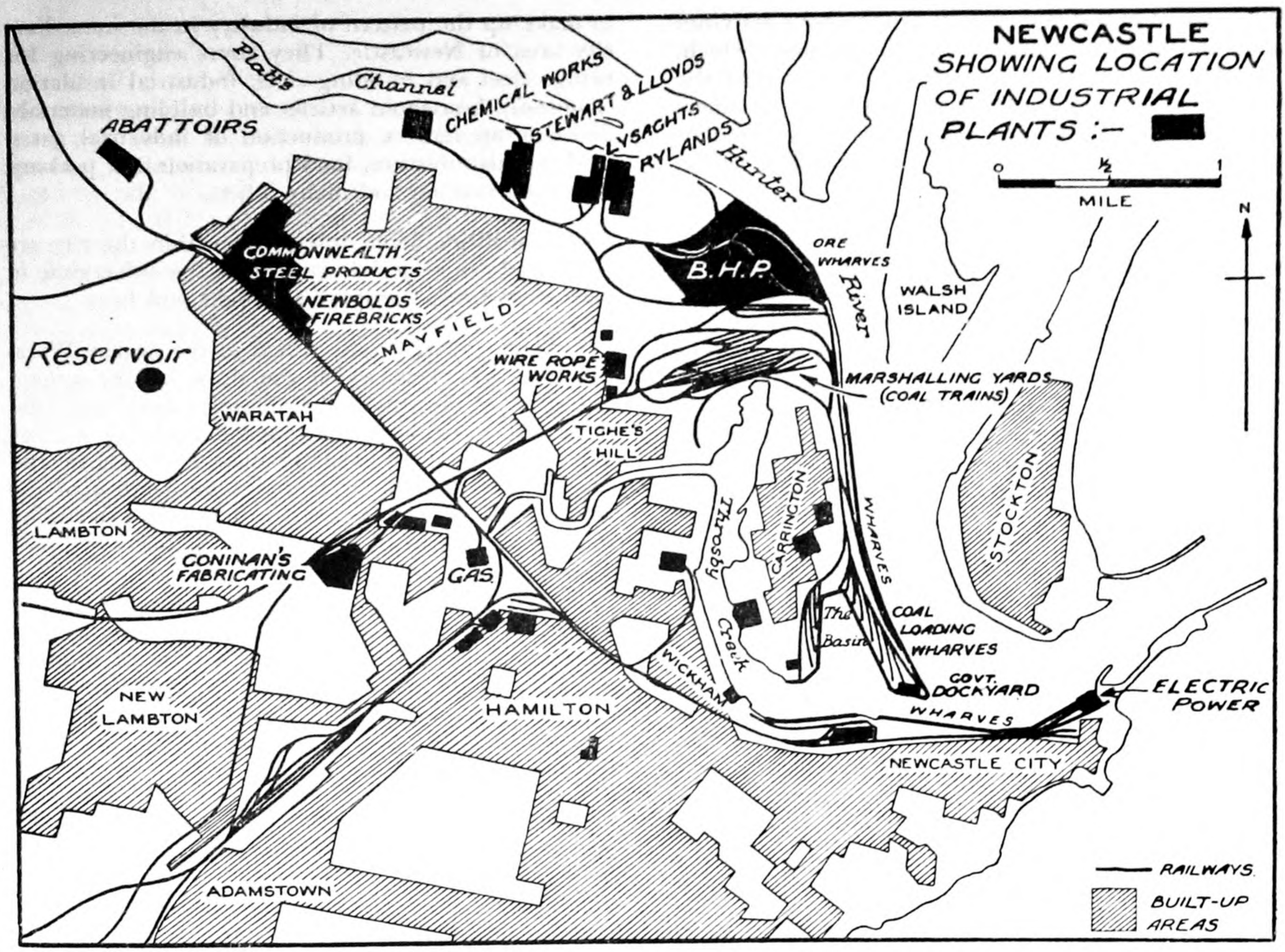


FIG. 61: Hunter valley: regional location of industry in Newcastle.

the State authorities, these include a 15,000-ton floating dock, mechanised wharves, and extensive workshops to cope with all classes of shipbuilding, ship repairing and engineering requirements.

Broken Hill Proprietary Steel Works. This large and important plant is located at Port Waratah, a spot where the river turns south into the harbour. Its special geographical features include the following:

(*a*) Although it was originally an area of swampland, it offered a tidewater site and the necessary room for expansion by the main works and allied industries.

(*b*) Reclamation was achieved by pumping sand into the marshes, and subsequently, by the dumping of slag with a tar covering; today the plant is a neatly finished area of about 300 acres some four feet above the old swamp level.

(*c*) The ore wharves shown handle iron ore from Whyalla (S.A.) and other steel-making constituents from State and interstate sources, e.g. limestone (Rapid Bay S.A.), as well as the export of steel products to other States and overseas.

(*d*) The blast furnaces and plant produce pig-iron, iron and steel goods (plates, billets, bars and rods) for export and local industries which are mentioned below.

(*e*) One of the most important processing units on the same site is that for the making of coke (necessary for use in the blast furnaces) and from it come coal gas (used in steel furnaces and as a heating agent in rolling mills), tar (road-making), creosote (wood preservative), naphthalene (pest extermination), sulphate of ammonia (fertilisers), benzol (motor spirit), and toluol (solvents, paints, varnishes).

(*f*) Further along the river other associated firms control various steel industries, e.g. Ryland's (wire and nails), Lysaght's (galvanised iron), Stewart and Lloyds (tubes and piping) and Imperial Chemical Works (chemicals for galvanising and glass making).

Other allied industries. As well as the above activities along the harbour front there are many more which, needing steel, opened factories and mills as near the steel works as possible. These in turn attracted others more remotely concerned with steel but dependent upon the industry in one way or another. Some of the larger ones are mapped here:

1. **Steel products.** The Commonwealth Steel Products Company at Mayfield is one of the country's largest steel works and manufactures special alloy steels for tools and construction work (machinery and cars); heat-resisting steels for industrial processing; and stainless steel. From this mill come almost all Australia's rail and tram wheels, tyres and axles. Other products include materials for shipbuilding, heavy engineering, hydro-electric and mining plants. There is a large export to the East, New Zealand and the Pacific generally.

2. **Silica firebricks.** The firm of Newbold's makes these special bricks at Mayfield. They are used for lining furnaces in heavy industries and so are in great demand in this region (for steel, gas, glass works, etc.). Silica is the main material used in their making and is brought mainly from Cooma and Nowra, New South Wales. Fireclays from East Maitland are also used, and other needed ingredients come from widely separated sources, even from overseas.

3. **Wire rope works.** The Australian Wire Rope Works supply all Australia's needs for light and heavy wire ropes, including a big demand for haulage and winding cables for mines and cranes which figure so much in local industry.

4. **Steel fabricating.** The firm of Goninan's has one of the State's important general and structural engineering concerns at Broadmeadow, where it occupies some 30 acres. Being in a coal-mining and steel-producing area it produces much mining, heavy machine and engineering gear. A branch specialising in engineering and colliery tools is established at Wickham.

5. **General engineering.** On the Carrington Peninsula is the pioneer engineering firm of Morison and Bearby. Its products cover a wide range such as boilers and machinery for mines, pumping, sugar mills, water supply and sewerage. Diesel locomotives and mechanical equipment for wharves are also turned out.

6. **Electrical goods.** A typical factory in the suburb of Hamilton is that for glass and lamp making developed by Electric Lamp Manufacturers. Products range from general domestic types to those used in streets, trains and floodlighting.

7. **General manufactures.** In addition to the examples given above many other smaller industries go to make up the pattern of industry in the immediate city area of Newcastle. They cover engineering for bridge steel and building steel, industrial insulation (slagwool), household articles and building materials, domestic appliances, production of industrial gases, clothing manufacture, food preparation and packing, furniture- making and many others.

Special utilities. Some enterprises within the city are concerned with special services to the sub-region in matters of food, transport and light and heat.

1. **Food.** (*a*) *Abattoirs.* Allied to the nearby Waratah livestock yards, which can draw on the animal industries of the valley, the abattoirs slaughter, dress pack and freeze beef, mutton and pork for a large export trade, as well as supply meat to Newcastle and surrounding districts. It is under the control of the Municipal Council, but trades with retailers, including those interested in by-products like tallow, fertilisers, oils, etc.

(*b*) *Cold storage.* The largest plant is privately owned by the firm of Dark and Company and is situated on the harbour front. All types of produce from the valley and north coast are stored for local consumption and overseas export, e.g. butter, eggs, rabbits, pork, fish, poultry, etc. Ice- making is a main feature of these works.

2. **Transport.** A note has been made already of the importance of the railway pattern, but it remains to mention

(*a*) the railway workshops at Cardiff where locomotive construction is undertaken on a large scale;

(*b*) the locomotive service department at Broadmeadow;

(*c*) the coal traffic locomotive and marshalling yards at Waratah;

(*d*) carriage and waggon repairs at the Honeysuckle workshops.

3. **Light and heat.** Earlier reference was made to the location and nature of the provision of electricity for the city, but gas service is also important. The works are situated in the suburban area of Hamilton. Gas is stored in tanks nearer the centre of the city, and supplies are piped under the harbour to Stockton. The coal utilised is from the Greta seam, which has been mentioned as being among the best in the world for gas-making. All domestic needs are met and there is an increasing demand from the surrounding industrial organisations.

Related industries outside the urban area. Certain industries close by have important relationships to those within the city.

1. **Sulphides and cement.** Situated about 10 miles from Newcastle at Cockle Creek on the shores of Lake

Macquarie are the works of the Sulphide Corporation. Their site was determined by proximity to water supply, port, rail and road transport, and remoteness from residential areas because of noxious fumes. They supply the needs of many steel, constructional and chemical industries of the sub-region and beyond. Sulphuric acid is made by roasting zinc concentrates from Broken Hill and burning sulphur from Texas, U.S.A. This is used in heavy industries for producing sulphate of ammonia from the coke ovens, for cleaning the surface of steel before galvanising, and for making superphosphates for fertilising croplands and pastures. Mixed manures for orchards and vegetable growing also come from this plant. Cement is made from shell dredged from the harbour and gypsum from Conoble on the Broken Hill line.

2. **Textile-making.** Proximity to a port, transport, abundant supplies of water and power, open space for factories, and a source of female labour in rural centres are factors which have led to the establishment of textile mills at a short distance from Newcastle. These are

(*a*) *Burlington's textile mill at Rutherford* (25 miles from Newcastle) near Maitland. Thousands of yards of rayon material, upholstery fabrics and tapestry are made each week from Australian wool and imported English and American raw materials. These products supply only the Australian market.

(*b*) *Courtauld's at Hexham* (11 miles from Newcastle). The 500-acre plant here is still in course of construction. It will produce rayon yarn and staple from imported Canadian pulpwood. It is estimated that about 4,000 people will be employed, many of them experts and skilled tradesmen.

3. **Timber products.** Processing of timber to obtain compressed-wood boards is a comparatively new industry to Australia, but the Masonite Corporation works at Raymond Terrace, 17 miles from Newcastle, have been extremely successful. Adequate coal and adjacent timber and water resources are important for this type of manufacture, and its present location and transport facilities have enabled these raw materials of the district to be drawn upon easily. At present an Australia-wide demand is being made for this kind of product because of its versatility, especially in the building trades.

Built-up areas. As shown on the map these include only (apart from industries just described) the location of the various suburbs, major rail lines and port. Other details would include these further general aspects of the city's geography:

1. By reason of its location on a restricted site, the striking feature of the core is Hunter Street, a two-mile long hub of retail and commercial activities with adjacent storage and transport facilities on the harbour front.

2. Each suburb shown has a similar centre meeting local needs, but fast bus transport brings many people direct to the city core.

3. Residential areas are spread over the small plain; but with industrial expansion they are extending to the hills and especially to the north towards the Port Stephens district.

4. Recreation facilities include the ocean beach frontages, parks and sports grounds.

5. Much vacant land remains to be taken up. Its future development is being carefully controlled by municipal planning, which aims at

(a) a zoning system to segregate heavy from light industrial areas, and these from residential and semi-rural areas;

(b) a streamlining of communications in all forms of land, sea and air transport;

(c) community grouping, in which the city will be divided into a number of self-sufficient districts, each served with full housing, shopping, health, transportation and other needs;

(*d*) more open spaces to provide the lungs of the city.

From the above it is easy to appreciate why Newcastle is now Australia's third port and how this status depends upon a large number of geographical factors, including the port site, coal resources and the many rich and varied products of the hinterland.

Projected flood mitigation and water conservation works (Figure 62). Within the Hunter valley the population exceeds 250,000, of whom the greater part (approximately 85 per cent) live in the lower valley area below Singleton and mainly in the industrial centre of Newcastle. This important sub-region has the rural sections of the valley as its immediate hinterland, and as has been shown, the economic connection between them is real and effective. In the combination of the two types of function there is an almost complete economic unit, with most phases of rural and industrial development already in existence. The industrial phase is expanding so rapidly and making such increasing demands for rural products to supply both Newcastle and Sydney (the latter alone draws one-third of its milk and large amounts of meat and vegetable supplies from the valley) that urgent steps must be taken to conserve the rural lands. After nearly one hundred years of exploitation, misuse and neglect, the valley of the Hunter and the catchment area of its tributaries are in a deplorable condition. The major cause is in the history of land settlement, when, over eighty years ago there was a ruthless cutting down of forests throughout large areas of the valley. This was especially marked in the higher lands of the Muswellbrook and Murrurundi districts and from Singleton to Jerry's Plains and Denman. Little gain in the flow of stream water was obtained by this clearing and in any case it was purely a temporary phase, for when the timber cover went and the rain water drained more quickly from the land, the soil started to move with it. This was worsened by further clearing and bad farming methods on the slopes and in the higher head-water regions, until today not only is much of the soil covering gone, but the banks of the streams are broken, the channels are gouged out or silted up, the former steady stream flow now scarcely runs, and floods sweep down in rainy weather to cause widespread devastation on the farmlands, mines and townships of the lower valley, as indicated on shaded area of Figure 62.

Thousands of acres of formerly fertile, productive land are ruined by all types of active water erosion.

To meet this extremely serious situation the State Government has prepared a regional scheme to plan for (*a*) the mitigation of floods; (*b*) water conservation and irrigation; (*c*) forest and soil conservation.

Mitigation of floods. The valley floods, assisted by the man-made devastation outlined above, usually occur in the following manner:

(*a*) Frequent and unpredictable rainstorms sweep over the whole region and cause rapid rises in all the rivers.

(*b*) The waters from the Williams and Paterson rivers reach Maitland first as indicated on Figure 62, and so dam up those from areas higher up the valley.

(*c*) The Wollombi River generally contributes more water than any other tributary and so adds to the flooding of the lower valley.

To overcome this it is proposed to build a series of dams at selected strategic points in the basin. These aim at checking the rise in the main stream until the flood waters from the Williams and the Paterson have receded. When the flood danger is passed the dams will be emptied and so will not be usable for permanent irrigation work along the valley.

Water conservation and irrigation. Dams have been planned also to improve the river flow and to supply water for irrigation development by individual landholders. The location and acre-feet capacity of these have been indicated on the map. Glenbawn, Brushy and Kerrabee are the dams planned. The other five are to be used essentially for flood control. Of these the Glenbawn is being built as fast as possible and there are some interesting facts about it:

(*a*) It is being constructed on the Hunter River about seven miles upstream from Aberdeen.

(*b*) Special methods are being employed in its design and structure, one of which is the use of rolled earth-fill and rock-fill from the immediate locality.

(c) Its function will be to improve river flow and provide for irrigation development along the upper and middle Hunter.

(*d*) The improved river flow will be used mainly for irrigation, domestic and stock purposes by rural landholders on the river flats between Scone and Denman.

Forest and soil conservation: Forests. Mention has been made of the devastation caused in the valley by the initial removal of the forest cover. Even to-day only about 175,000 of the four million acres in the basin are reserved for State forests and much of this is in the more rugged head-water land. The Forestry Commission has the task of preserving what remains by clearing and bushfire protection and extending it by re-afforestation. The job is being undertaken in a number of ways, of which the most important is that relating to the dams. Thus at Glenbawn the 30,000 acres of catchment are under protection as reservations so as

(*a*) to prevent destruction of timber in the catchment;

(*b*) to prevent siltation of the dam under construction;

(*c*) to allow planting of trees to make the catchment secure.

This type of procedure will be followed in the case of the other dam construction planned.

Soil conservation. Thousands of acres of land in the valley have been lost or badly affected by soil erosion in the past. In addition, present bad farming practices represent potential erosion risks on land being used for grazing and crop-growing, e.g. ploughing down slopes instead of with the contour of the land, allowing gullies to develop on properties, pasturing cattle on steep slopes, etc. These faults are being overcome by such measures as

(*a*) close application of soil conservation methods on the catchment areas for the new dams;

(*b*) proper staffing by trained conservation officers to do experimental work, cultivate special grasses, give demonstrations to farmers, and generally provide education in soil conservation;

(*c*) hire of plant to aid agriculturalists to treat properties so as to cure past and prevent future erosion.

Other conservation measures contemplated include the improvement of the river channels by stabilising the banks in the upper and middle reaches and enlarging the existing channels between Maitland and Newcastle.

Possible agricultural developments. The conservation measures outlined above are to prevent further deterioration in agricultural lands and at the same time allow scope for their future development within the valley along the following lines:

(*a*) *Dairy cattle.* Greater and assured supplies of water on a regional basis would permit improved pastures and better organisation of fodder supplies for dairy cattle. In this way milk supplies for the urban districts could be stabilised and increased.

(*b*) *Pigs.* Irrigation would facilitate the growing of green feed, so necessary in the raising of pigs, along with dairy farming.

(*c*) *Beef cattle.* The development of irrigation would assist very much in the fattening of beef cattle herds in the upper Hunter, where proximity to the abattoirs of Aberdeen would be an added advantage.

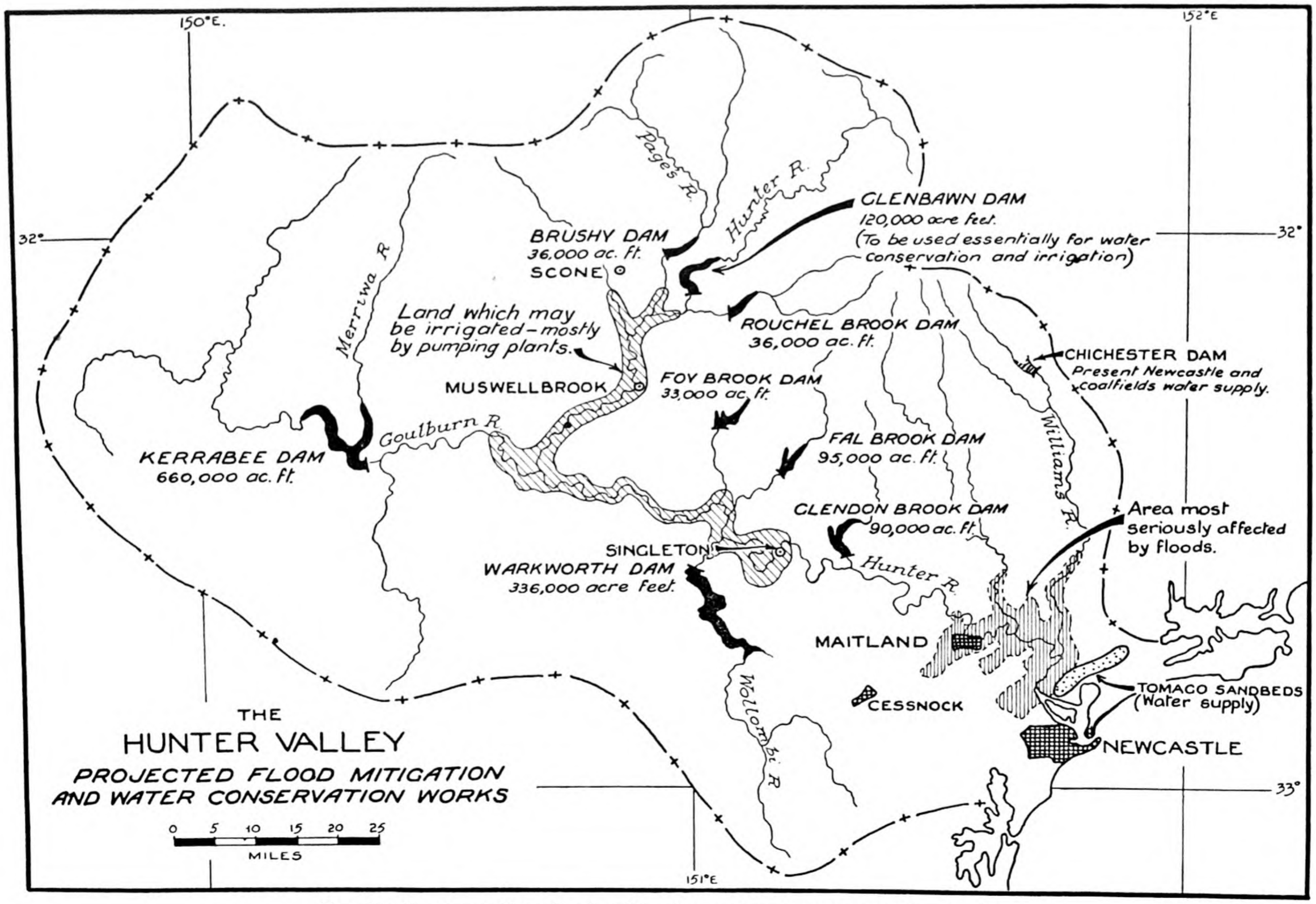


FIG. 62: Hunter valley: flood mitigation and water conservation works.

From these and previous notes and maps it is clear that in spite of the value of steel and coal, agricultural production has been a consolidating factor in the valley's progress, and without it the same degree of over-all prosperity could not be maintained. It is worth spending many millions of pounds to conserve water, soil and forests in regions that are wholly agricultural; how much more so is it to be recommended when the future of a valley so richly endowed by nature as the Hunter is at stake.

Movement of Raw Materials in the Australian Iron and Steel Industry

Figure 63 shows how the steelworks and smelting plants at Newcastle and Port Kembla draw their raw material from widely separated areas.

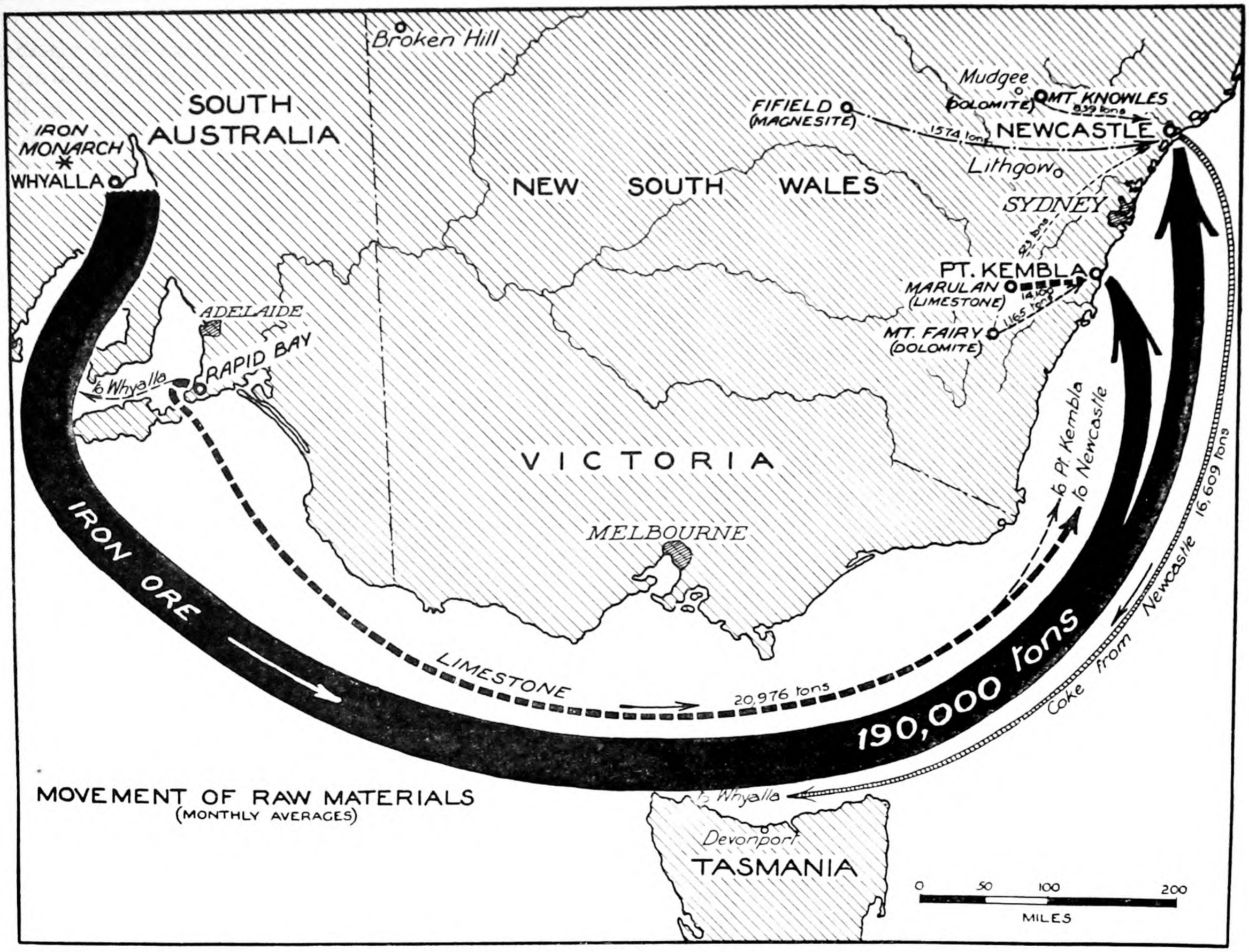
It also indicates the variety of materials used in steel-making, together with the approximate amounts of each used, excluding coal, which is about equal to iron ore in amount.

Related closely to these is the vertical integration within the steel industry. Modern steel-making plants, for purposes of economy and efficiency, endeavour to extend ownership and control backwards from the steel plants to the supplies of raw materials; and forward from the plant to the fabricating works which produce consumer goods for the market.

In the Australian steel industry this process is virtually a full one, since the principal companies own all the sources of raw materials and all the transport facilities handling them except the railways in New South Wales. In addition, they have a major controlling interest in many of the associated fabricating plants and the sections of manufacture, producing and selling by-products from the main plants.

One result of this form of integration in Australian industry has been the ability of the B.H.P. Company to produce high-grade quality steel at a cost considerably below that paid for similar quality material in either U.S.A. or England, and that in spite of higher wages paid here (1947).

It should be noted that vertical integration referred to here is really an economic form of integration and must not be confused with the geographical integration referred to later in the discussion on integration within geographical regions (see Chapter 12).



MOVEMENT OF RAW MATERIALS
(MONTHLY AVERAGES)

FIG. 63: Hunter valley: movement of raw materials in the iron and steel industry.

LIVERPOOL-MANCHESTER PROVINCE

Introduction. The Manchester-Liverpool province is situated on the north-west coast of England and forms the core of the greater geographical region of Lancastria. Long and successful use of natural resources of coal, chemicals, water and soils as well as of imported raw materials in a special environment of landforms and climate has here developed one of the most highly industrialised regions in the world. Within it the major geographical aspects concern

(*a*) complex integration of the many processing activities associated with the cotton textile industry;

(*b*) the special significance of the nodality of its chief city of Manchester;

(*c*) the phenomenal growth of Liverpool, not only as the main entrance to Lancastria and western Britain, but as one of the leading seaports of the world.

To understand the growth and present geography of these features of the region we begin with its physical geography.

The physical regions. Within the geographical province of Lancastria the physical divisions are fairly simple, and as Figure 64 shows, consist essentially of a wide plain, bounded on the west by the Irish Sea and on the east by higher country rising to the Pennine chain of upland moorlands.

The plain. 1. The plain surface is mostly flat or gently undulating, being seldom 300 feet above sea-level.

2. The scenery and soil characteristics have been modified by glacial and post-glacial deposits, so that the plain is covered with glacial sands and clays and some peat, and fringed with a belt of sand dunes along the coast.

3. The coastline is broken by three river estuaries, the Dee, the Mersey and the Ribble. Of these the Mersey, by reason of its shape, is scoured by strong tidal action and so kept fairly free of silt. But the other two are not cleared so effectively and so suffer from blocked channels.

4. The river systems which flow into these estuaries are not extensive, but they have an effective arrangement of tributaries rising in the hills and valleys to the east. They flow in a general south-westerly direction to the sea across the plain, with the Mersey lowland the most extensive. The sluggish movement of waters has been responsible for meandrine shallow courses and marshlands in the lower reaches in several instances.

5. Two important rock foundations come together on the plain in the vicinity of the Manchester area:

(*a*) Lying to the south and west under the flat deposits already mentioned are the Trias or Red rocks which are rich in salt and quantities of valuable hard water.

(*b*) To the north and east are the Carboniferous rocks which contain coal and some iron ore; they are not flat, but folded into hills and moorlands which rise gradually to the uplands of the Rossendale "forest" and part of the Pennine Chain.

The physical features of the plain are important for three reasons

(*a*) The level nature of the plain, with its drainage pattern and tide-scoured ports, has been important in the development of an intensive rail, road and canal net, so necessary in modern, large-scale industry, transport and building.

(*b*) The types of rocks have provided coal and deposits of salt and industrial supplies of water.

(*c*) The soil types of the peat mosses, heavy clays and loams have formed the basis of the agriculture necessary for an abundant supply of food to industrialised areas.

The uplands. To earlier remarks on these, in connection with the Yorkshire region (see Figure 4), we add the following notes on their physical features:

1. There is a gradual rise eastwards from the plain, showing that the Lancastrian highlands of the western Pennines represent a folding of the Carboniferous rocks.

2. They provide a barrier to the rain-bearing wind streams from the west and so have an important bearing on the rainfall and climate of the region. See under "Climate" below.

3. The uplands as a whole form the gathering ground for numerous streams of abundant soft water.

4. In their lower courses these streams have developed several larger valleys which open out to the plain, and in general tend to converge upon the Manchester area.

5. The western offshoots of the uplands form important divisions between the major valleys, e.g. the Rossendale upland between the Ribble and the Mersey, and the Bowland upland between the Ribble and the Lune.

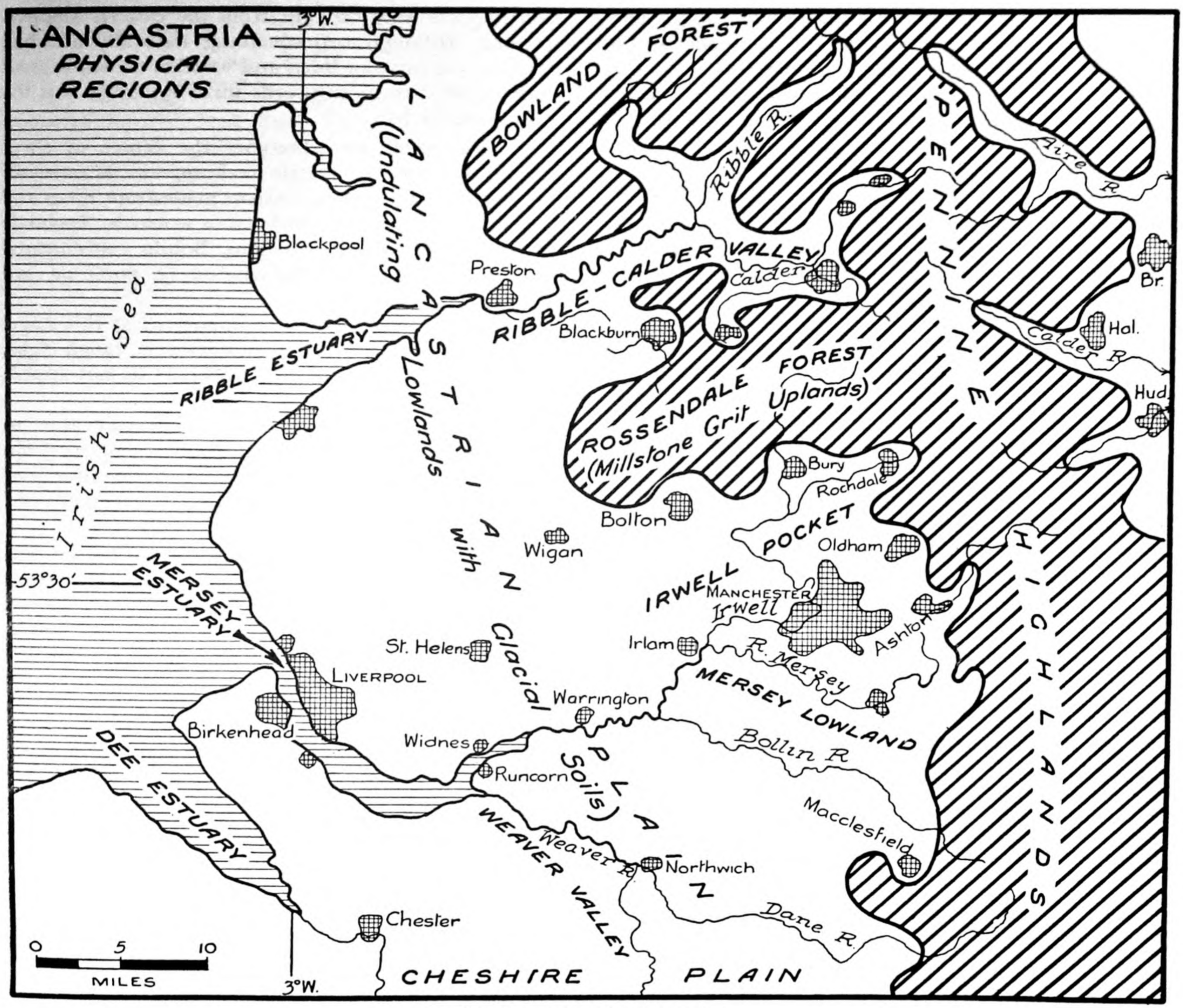


FIG. 64: Lancastria: physical regions.

6. The nature and extent of the Ribble-Calder valley (note that Yorkshire has a Calder valley also) and the Irwell pocket developed low watersheds and saddles over and through which it was possible to build important lines of communication with Yorkshire to the east.

7. The important deposits of Millstone Grits and the coal measures have been exposed and made accessible in large areas.

The above physical features have a closer relationship with the pattern of industrial development and population spread in Lancastria since

(*a*) the coal seams of the slopes are important to many types of manufacturing concerned with textiles and associated industries;

(*b*) the Grits (apart from their value as building and paving stone and road metal) are responsible for the softening of the water which is one of the determining factors in the localisation of the textile industry—especially its localisation in the upper valleys of the Irwell, Calder, Roch and Mersey rivers;

(*c*) the valleys and divides have determined the direction of development of various types of transport both within the region of Lancastria and adjacent to it, e.g. Yorkshire.

Climate. Lancastria receives full benefit from its western position, which exposes it to cyclonic storms moving in from the Atlantic. This gives it a uniformly distributed and abundant (25 inches to 50

inches) rainfall and a characteristically mild and humid climate. This factor is not as important in localising cotton spinning and weaving as was once supposed; but it is certainly an advantage in cotton-spinning and accounts in part for the location of the spinning towns south of the Rossendale upland, where conditions are more humid. The rainfall is of outstanding benefit to a region which requires an almost unlimited supply of pure water for its major industry.

Lancastria comprises two contrasting physical regions. In the industrial and commercial development of the province the divisions of upland and lowland have been marked by so close a relationship that each has become complementary to the other. This is more clearly understood when it is realised that within the regional boundary there is a group of closely integrated agricultural, mining, manufacturing and trading activities. The mining is for coal and salt, and the manufactures are concerned essentially with (*a*) cotton yarns and materials; (*b*) production of steel ingots and steel goods of many types; (*c*) machinery and machine-shop products (for which the region ranks first in the world); (*d*) chemicals and dyestuffs; (*e*) glassware; (*f*) food processing (specially flour, margarine, plant-oils and sugar refining).

As well as the geographical factors just outlined, certain historical features of the province are relevant to its growth as an industrial region, associated particularly with the textile trades (see Figure 65).

Figure 64 should be used as a basis of reference for the subsequent map series on Lancastria. Place names are important.

Historical factors in the development of the cotton industry. Figure 65 summarises in diagrammatic form the major historical factors which contributed towards the localisation of the cotton industry in Lancashire. The following points are worthy of notice:

1. The earliest textile industry was that associated with the making of woollens; it is recorded that Manchester made woollen cloths in the early fourteenth century. This was due in part to the Pennine uplands' suitability for sheep-raising. Water there was plentiful and free of lime, and its flow useful (at later stages) for the turning of wheels. The coarse woollen cloths produced were called kerseys and the makers were located in the valleys, where their spinning and weaving were done in association with agricultural pursuits. This rural character was changed only a little when immigrant weavers from Flanders came across the Pennines (from Yorkshire) and helped the industry develop so much that it outgrew the local supplies of raw materials and began to import from Ireland and the Midlands.

2. About the end of the sixteenth century the use of cotton came into being here for the making of fustian, a cloth derived from a mixture of cotton and wool. This process spread into south Lancashire, where many foreigners had settled and to which cotton imports were brought from the eastern Mediterranean. Although cotton-making naturally attached itself to the existing linen and woollen trades, it gradually pushed them eastwards until Rochdale was the main district left.

3. Manchester now becomes the centre of three important types of textile making, viz. Manchester cottons (made of wool), fustians made from linen and cotton, and small-ware made from worsteds. Rochdale continued to produce woollens, Bolton concentrated on the fustians, and Warrington (a port) on sail cloths.

4. Other centres were not important at this stage, for Oldham had only five manufacturers, Leigh eight, whilst Bury, Stalybridge and Stockport do not appear at all.

5. Manchester as a growing town was able to develop the above industries because it was free from the strict trade regulations of other larger cities and so could encourage the settlement of foreigners and the rise of textile processes of a new type.

6. During the seventeenth century Chester had been the main port for Manchester, being the natural seaward terminus of a route through the marshlands to the north and the Cheshire gateway to the south. As well, it was strategically placed in relation to Birmingham in the Midlands and to London. But the Dee estuary gradually silted up and so Chester declined in importance. At the same time Liverpool, hitherto suffering from the disadvantages of sand banks and difficult channels, gradually became more important with the steady but slow expansion of the cotton industries in Lancashire in the first half of the eighteenth century. Recognition of its possibilities as a new seaway was to be seen in the building of wet-docks there at this time, and the improvement of Mersey-Irwell navigation.

7. With the onset of the Industrial Revolution and the switching to the American States for supplies of raw cotton, Liverpool gained enormously on the position it had begun to build up by its West Indian, Irish Sea and English coastal trade. This gave impetus to a big programme of road and canal building. One of the most important of the canals was that stretching from Liverpool to Leeds via a series of industrial centres and the Aire-Calder Gap. Subsequent developments of railways and roads reduced its value and significance for Lancastria, though it still carries over 2 million tons of goods a year—more than any other canal in Britain.

8. The cotton industries underwent a series of changes and re-orientations which finally gave them world standing. Their continued expansion was still in part the result of factors such as suitable water, imported skills and humid atmosphere; but on the whole it was due to the fact that as each new development arose some part of the region was found capable of allowing it to be utilised, e.g:

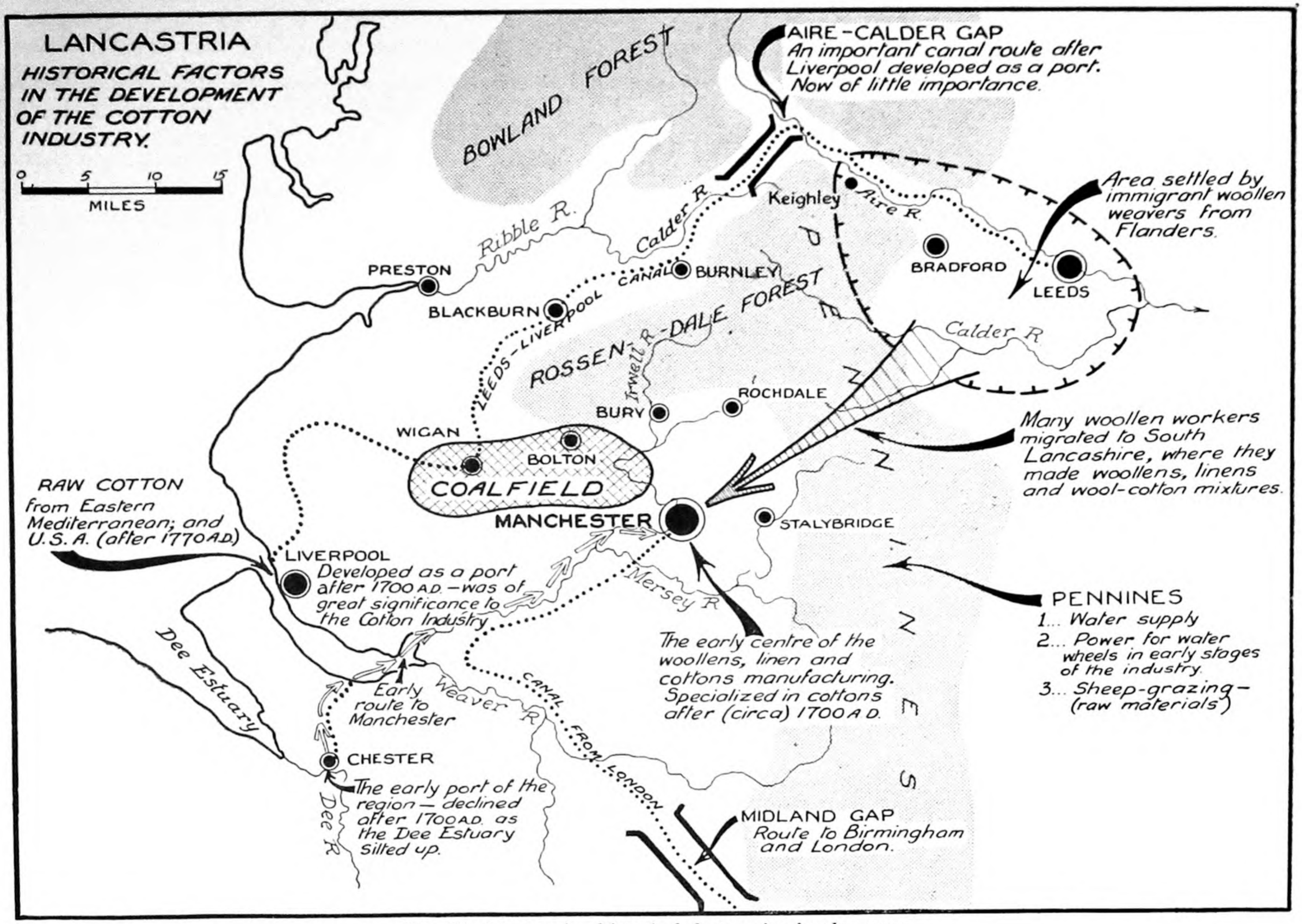


FIG. 65: Lancastria: historical factors in development.

(*a*) When machinery was invented water power was available from the uplands to the east.

(*b*) When steam power appeared and was applied to newer inventions of cotton textile machinery, coal was on the spot right next to the very places where the industries had received their initial foundation.

(*c*) When chemical processing was initiated for bleaching and dyeing, the salt fields of Cheshire were near at hand with an abundant supply of raw materials.

(d) As transport needs grew the level land enabled a network of railways and roads to be constructed easily for the handling of bulk imports and exports.

(*e*) The canalisation of the Mersey with its tremendous influence on the industries and trade of Lancastria was made possible by the fairly smooth grade of the land and the slight fall of the stream.

9. In its modern growth Lancastria has shown the following trends:

(*a*) Its expansion has been followed by a decline relative to the world's total of cotton goods. Expansion northward was barred by absence of coal, distance from the main economic centres of the industry, and unsuitable water from the limestone areas.

(*b*) There has been an increased separation of spinning and weaving mainly because of the increasing range in yarns and fabrics which can be produced. No firm could possibly hope to make the varieties which are now possible, so they have remained small in order to specialise in certain types of products only. Overseas manufacture of cheaper and poorer quality goods has also led to this development.

(*c*) There have been various changes in the use of transport, the road now tending to be the chief means of moving raw and manufactured cotton goods, whereas formerly it was the railway, and before that the canal. This should be noted in connection with the Manchester Ship Canal.

(*d*) The expansion, alongside textiles, of trades concerned with the making of machinery for this special work. Motor car (truck) and chemicals are notable in the same way.

(*e*) The movement away from the use of coal as a source of power to that of electricity obtained from the grid system set up over England.

In studying Figure 66 a number of significant geographical facts may be deduced, especially in the light of the points already made with respect to Lancastria's physical, manufacturing, commercial and agricultural aspects. The following are some of the more interesting features:

1. The specialised function of the largest settlements shown, i.e., Liverpool and Manchester, as ports and trading centres.

2. The specific interest of each settlement shown, in terms of the textile trade, or associated industries, or newer industries. For example, the contrast between Blackpool (recreation), Accrington (weaving), Bolton (spinning), Wigan (coal), St Helens (copper refining and glass making), Runcorn (chemicals) and Macclesfield (silks).

3. The tendency towards conurbation and satellite townships about the older cities, e.g. Liverpool with Birkenhead and Bootle.

4. The contrasts between the settlement patterns of the plain and the higher lands, e.g. the density of the northern parts as against the south; the smaller townships along the upland valley streams, and the growth of ports and industrial concerns along the Manchester Ship Canal.

5. The number of townships with populations of over 10,000. There are about $4\frac{1}{2}$ million people within 25 miles of Manchester, making it one of the most densely settled regions in the world.

6. The comparison possible with the woollen and steel industries of Yorkshire across the Pennines. Much the same type of aggregation will be found, especially in relation to the uplands.

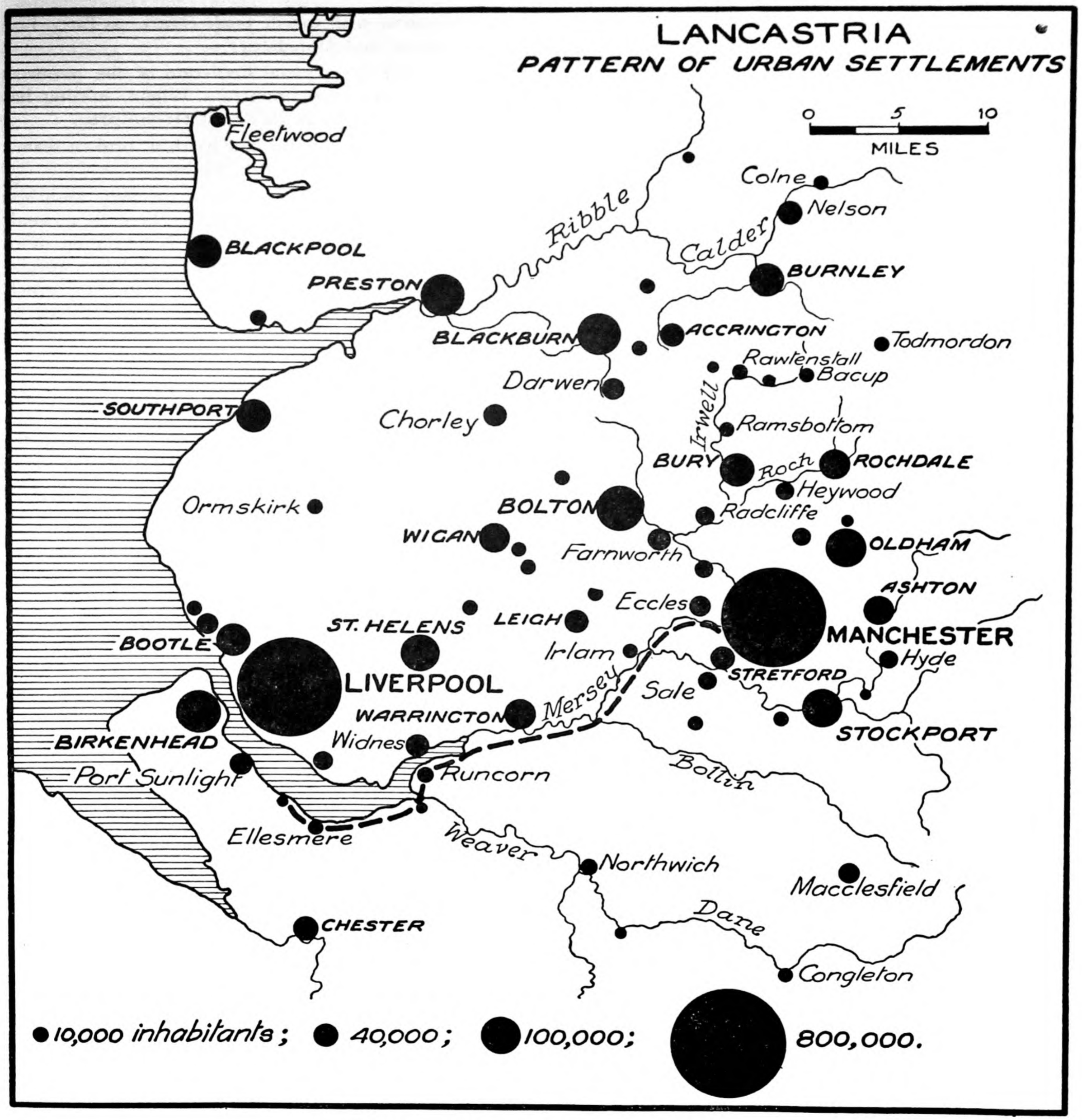


FIG. 66: Lancastria: pattern of urban settlement.

Before making a detailed examination of the various activities shown in Figure 67 some general observations are useful by way of introduction.

1. There is a marked variety of activities within the region of Lancastria. This is especially striking when it is observed that they are spread over the relatively small area of about 400 square miles.

2. There is an over-all integration of associated and contrasting types of activities which give the region its own special character and entity, and which thus provide a good example of the geographical interpretation of integration as discussed at the end of this chapter.

3. The significant location, largely central, of the region concerned with the generation of power so important to industry, i.e. the coal-mining region.

4. The importance of water supplies from the Pennines, both for industrial and domestic consumption.

5. The relative positions of the spinning and weaving trades and the determination of these by historical as well as geographical factors.

6. The specialised nature and situation of the chemical, steel, paper and silk manufactures.

7. The widespread nature of the farming regions and their importance to the industrialised sections of the Lancastrian province.

8. The multiplicity of activities associated with the canal-port features, apart from actual transport, including much processing, especially of foodstuffs. This has a special significance for Liverpool.

9. The multi-purpose function of Manchester, not only as a trading and market centre, but as a machinery-manufacturing centre associated in the main with the textile industry.

10. The need for, and the popularity of, the watering places as recreational areas for the industrial population of Lancastria.

Coal mining. Although the Lancashire field was once joined to that of Yorkshire the erosion of the Pennine uplands removed the connecting seams. Nowadays it is a relatively small area of which the following are the main features:

(*a*) There are roughly two main sections of the field, one around the northern edge of the Rossendale upland (including such towns as Burnley, Accrington and Blackburn), and the other about the southern edge and extending west and east to include Wigan, St Helens, Bolton, Bury and Rochdale. Smaller parts flank the Pennines from Rochdale and Stockport to Macclesfield.

(*b*) The most important area is that of south-east Lancashire. This has assisted strongly in the localisation of such textile trade centres as Bury, Bolton, Oldham and Manchester.

(*c*) With the gradual depletion of the resources about the once very important Wigan, mining has moved south generally to the St Helens area.

(*d*) Production is limited by thin, broken seams; some coal is mined at great depths.

(*e*) Coal produced is almost entirely absorbed locally and by coastal shipping. There is a small export trade. Although electricity is becoming more significant in mills and factories, coal has a special interest for many of the newer industries which specialise in the treatment of coal by-products, of which the most important are dyes, medical products and plastics.

Salt mining and the manufacture of heavy chemicals. The salt supplies of Lancastria occur along the Weaver valley in Cheshire. They are obtained by pumping water into old mines, extracting the saturated solution and evaporating it. It is used as the basic chemical in the many large chemical industries situated along the middle Mersey and localised in such centres as Widnes, Runcorn and Northwich. These supply materials for a number of commodities which are used directly or indirectly in the manufacture of many other goods, e.g.:

(a) the cotton industry: dyes, bleaching powders, and mordants for the many different textile fabrics;

(*b*) the glass industry (St Helens): salt cake for use with sand, flints and lime;

(*c*) the manufacture of soap (Port Sunlight): caustic soda for use with imported vegetable oils;

(*d*) the leather industry (Runcorn): chemicals for various stages in the tanning processes;

(*e*) Fertilisers (for farms in the region), paper and explosives.

The salt for use in the above types of manufactures is brought by barges along the river and the Weaver Canal. On the whole, the chemical industries based on these salt deposits rank with coal, cotton and engineering as one of the great industries of Lancastria.

Seaport and canal-port activities and waterside processing industries. The port of Liverpool. Liverpool is second to London as a British port, and between them they share about half the overseas trade of England. By reason of its location, facilities and function as a focus for the Lancastrian province, it handles the major part of its imports and exports as well as having strong ties with adjacent regions. Its major geographical features may be summarised as follows:

(*a*) It is situated on the Mersey estuary, which

by reason of its bottle shape is scoured by daily tidal action and thus to a great extent kept clear of the silt brought down. Of recent years, to improve this scouring action of the tides, training walls have been built further out to sea in what is known as Liverpool Bay; but a considerable amount of dredging is still necessary to keep open a good deep-water channel. As a result the largest ships can now pass through it to be berthed at a huge floating stage, where they are sheltered from all winds except the north-west. These and many other improvements are intended to offset the loss of much trans-Atlantic traffic to the southern port of Southampton.

(*b*) An efficient wet dock system of some 500 acres and a quay frontage of about 30 miles have been developed on the northern or Liverpool side of the estuary. By way of contrast the southern or Cheshire side of the estuary has not such a continuous line of dockland, although there are about ten miles of quays and a water area of nearly 200 acres.

(*c*) On the southern shore are the commercial and industrial town of Birkenhead and the dormitory suburb of Wallesley. Between these and Liverpool there is a close connection by means of the road through the Mersey tunnel, railway and ferries, all handling great numbers of workers daily.

(*d*) In addition to the above transport features, three main railway systems concentrate on Liverpool and Birkenhead, one operating its own port.

(*e*) The great Manchester Ship Canal terminates east of the port and is responsible for enormous water transport.

(*f*) The city of Liverpool itself covers an urban area of land much of which is slightly higher than the surrounding country and is separated from the Lancashire plain by low-lying parts. These are being utilised now for agriculture and parklands. There is an interesting zoning of the city:

(*i*) The dockland monopolizes the foreshores with quays, warehouses, etc.

(*ii*) At the rear of this is the city core, with an adjacent zone of public buildings and professional and administrative offices.

(*iii*) Arranged about the above is the older residential area, much of it slums, now being cleared and rebuilt along modern town-planning lines.

(*iv*) On the margins of the city are the newer residential sections reaching out into an extensive and developing system of parklands.

(*v*) The industrial zones are located near the shore-line industries of the estuary, many of them upstream.

(*vi*) Many of the urban problems of housing, communication, etc., as created by earlier expansion in the Industrial Revolution, are being tackled by a vigorous system of town planning.

Port activities. The activities of the port can be divided, for purposes of description, into two general divisions, those concerned immediately with the port itself and those related to the hinterland.

1. Local industries. These have arisen from the development of shipping, bringing a wide range of commodities to a port where, because of the site and facilities available, they could be processed or assembled and then marketed in Lancastria itself, the British Isles and overseas.

The "imported character" of these industries can be seen if it is noted that the chief ones include

(*a*) shipbuilding, ship repairing, shipping tackle, general and marine engineering;

(*b*) processing of imported foodstuffs, e.g. meat, grain, flour, butter, margarine, and handling sugar, tea, also cattle foodstuffs;

(*c*) manufacture of chemicals, soap, plant oils, and refining of petroleum.

In the character and localisation of the industries it is also interesting to note that

(*a*) there is something of an isolation from the remainder of the manufacturing and commercial regions of Lancastria;

(*b*) the major industries have been forced inland because of the monopoly of the waterfront by docks, quays and warehouses, a fact which causes some expensive difficulties in transport, since the factories and mills cannot be supplied directly as in London.

2. Link with the industries of the hinterland. Many of the commodities mentioned above are handled at Liverpool on their way to the Lancastrian hinterland, either in the raw or processed state.

In addition, other imports include such important products as raw cotton, wool, timber, mineral oils, non-ferrous metals, iron and steel, hides and skins, paper, rubber and tobacco.

Liverpool, as the seaport focus of the region, is also closely concerned with the export, mainly of manufactured goods, from the local area and other industrial regions of Lancastria, as well as adjoining ones, e.g. Yorkshire. Examples of this can be seen in manufactured cottons and woollens, machinery, chemicals, pottery and soap. Most of these exports go to those countries which actually supplied many of the raw materials which came in as port imports, destined for the Merseyside or other Lancastrian manufacturers. As well as providing facilities for the handling of these and other products, Liverpool is a great passenger port for travellers to the Americas and Africa.

The Manchester Ship Canal. This was built in 1894 to meet the need of Manchester for a water link with Liverpool and so with the ocean lanes of the world; in spite of many improvements to the shallow courses

of the Irwell and Mersey rivers, they had proved inadequate. As a result of the construction work, which made the whole canal an elongated harbour, Manchester has now become one of the leading ports of the United Kingdom. The port of Manchester includes the whole of the Ship Canal, a waterway 35½ miles long, with its main entrance at Eastham on the Mersey River, six miles upstream from Liverpool, and its terminal docks at Manchester. The main geographical features of the canal are:

(*a*) Its depth ranges from 28 to 30 feet and there is a bottom width for most of its course of 120 feet.

(*b*) Five sets of locks assist in the navigation of ships up to 15,000 tons, but limiting factors are the sizes of the different locks, the height of fixed bridges, and the draught of ships arriving loaded.

(*c*) A wide range of ships can use the port, from barges, lighters and coastal vessels to overseas ships equipped with refrigeration space to transport perishables such as frozen meat, fruit and other foodstuffs. Other vessels include oil tankers, whalers, and those ships which are specially built to carry locomotives and rolling stock.

(*d*) A series of other canals link the Ship Canal with many of the country's inland waterways. A network of railways and roads also have a close connection with it.

(*e*) Spread along the shores is a highly mechanised series of wharves, quays, docks, storage sheds, silos, tanks and warehouses. The largest number of these is to be found in Manchester itself.

(*f*) Apart from general cargoes, the major commodities which are loaded and discharged along the Canal are timber and wood pulp, general, bunker and cargo coal, petroleum, chemicals, iron and other ores.

(*g*) The main dock points, going eastwards, are Ellesmere Port, a trans-shipment point for the Midlands and the Potteries, trading grain and general cargo *via* the Shropshire Union Canal; Stanlow, an important centre for handling oil and petroleum; Weston and Runcorn, the terminals of two inland canal systems, the latter another trans-shipment point for the Midlands and the Potteries, with china, clay, feldspar, grains and general cargoes *via* the Bridgewater and Weaver Canals; Partington, an important coaling point, Terminal Docks at Manchester, described later.

(*h*) Associated with the above and other docking points is a wide range of manufacturing industries.

Financial and wholesale trading with extensive manufacture of machinery. Manchester is the main financial and wholesale trading centre of Lancastria for a number of reasons. Some of these are historical in character and are illustrated in a separate map (Figure 65). At the present time its importance rests on its function as port, trading and commercial focus within a wide girdle of industrial cities having an aggregate population of over 10 millions. It is the gateway and *entrepôt* of all the province. Of its major functions the following are important geographical aspects:

(*a*) *Trade in raw materials and manufactured goods.* This covers a wide variety of commodities of which certain types of special significance, viz:

(*i*) Cotton. Raw cotton is the chief import coming to Manchester from a number of countries for several months of each year. From the city it is distributed to the various specialised manufacturing centres and is returned as cotton goods and yarns for British and overseas trade. It is estimated that over 55 per cent of these products pass through the Manchester docks for export to other countries.

(*ii*) Petroleum (crude and refined). Large quantities are brought in to meet the needs of industry and transport for lubricating, fuels, oils and petrol. In such a highly industrialised region the demands for such supplies are constant throughout the year. Some oils are refined for dispersal throughout the remainder of Britain.

(*iii*) Timber. This is for industrial buildings and houses for the huge hinterland population.

(*iv*) Wood-pulp and other paper-making materials. These are imported for distribution to the Lancastrian paper centres, where they are made into a variety of paper products like newsprint, wrapping paper, cartons, bags, labels and the like. Markets for these are found in England as well as overseas.

(*v*) Foodstuffs. The constant need of primary products to assist in feeding large urban populations means the regular importation of such products as grains and flour, tea, fresh fruits, meat, butter and cheese. These come in through the docks of Manchester either in raw or processed forms to supplement the agricultural produce of Lancastria and adjacent regions.

(*vi*) Ores. Iron ores and associated fluxes come to the steel works of Irlam on the Ship Canal (see later, under "Steel Manufacture") where they are made up into steel products and machinery for British or export use.

(*vii*) Cement and pottery materials. Coming from other districts of England, these are taken to different parts of the province specialising in certain types of industry.

(*viii*) Chemicals. The chemical industry of Lancastria is largely an exporting one, with drugs, dyes and colours making up as much as one-quarter of the total export of the country. Most of these pass through Manchester.

(*ix*) Manufactures from other regions. A large quantity of manufactured goods from regions like the Midlands and Yorkshire passes through

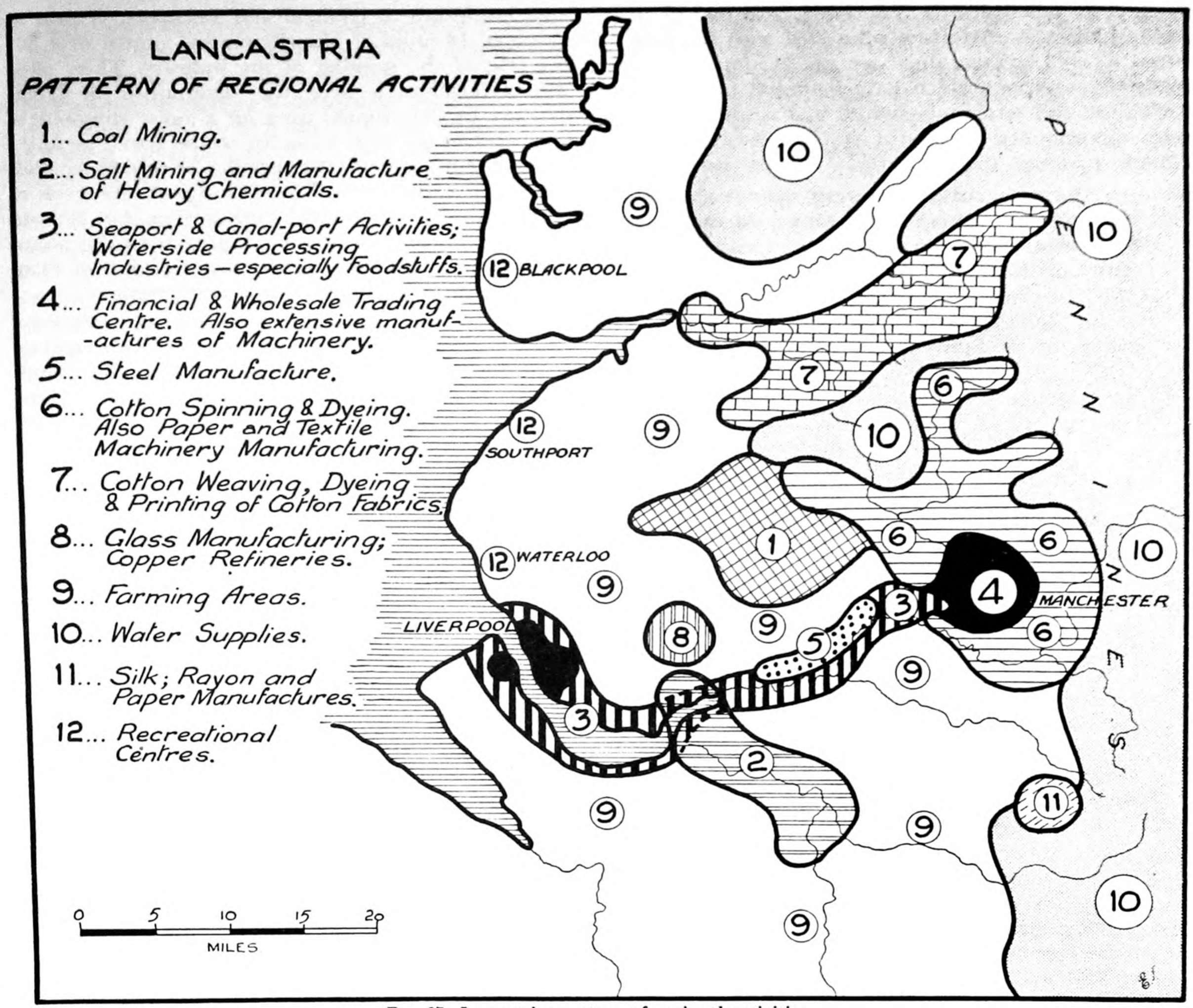


FIG. 67: Lancastria: pattern of regional activities.

Manchester. Included are machinery, woollen goods, yarns, iron and steel goods and hardware.

(*b*) *Docks and transport.* There is obviously a great need for facilities for such bulk cargoes as would be likely with the above products, to be transported into and out of the heart of Lancastria. For this reason the docks of the port of Manchester have developed every facility for their handling, and it is regarded as the most easily-worked port in the British Isles. Equipment includes many kinds of travelling and floating cranes, various docks, wharves and storage points such as grain elevators and quay sheds. These are supplemented by the port's own railway system in direct connection with the main line railways. In this way cargoes are distributed by rail over a very wide area. Road transport deals with much of the traffic to places within easy reach of the port. Much of the raw cotton is handled in this way. Altogether some 80 per cent of the commodities, excepting cotton, timber and grain, are moved away by rail or road. At the same time many imports into Manchester are re-distributed by water, to be used or manufactured elsewhere.

(*c*) *Commercial trading.* From the import, manufacture, and export of the numerous products mentioned above, it follows that Manchester is a large trading centre, and that a great deal of its trade is due to its port. Much of the buying and selling is done at a series of exchanges which because of their character are known, for example, as the Coal Exchange, the Corn Exchange, the Grocery Exchange, and the Produce Exchange. Manchester is second to

London as a British financial centre, and one of its leading business interests is connected with shipping firms. As well as these there are the headquarters of many organisations which have a special interest in the cotton and yarn trade and all its branches. Along with this commercial control of the industry, Manchester possesses these additional distinctions:

(*i*) Its northern and eastern districts have a high place among spinning towns. At one time they comprised the principal textile-making centre of the region.

(*ii*) It is the repository of the yarns and fabrics of the industry as a whole, and the one great market of the finished products.

(*iii*) The increasing expansion of manufacturing in cottons led to the city's specialising in the manufacture of textile-making machinery.

(*iv*) Because of the great number of surrounding mills, mines and factories, it has become one of the leading general engineering centres of Britain, making machinery for chemical, paper, and electrical industries as well as producing trams, cars, omnibuses and locomotives.

(*v*) The growth of the urban area of Manchester gradually led to a merging of its population with that of neighbouring towns, so that today there is hardly a break in the built-up parts between neighbouring towns like Oldham, Stockport and Salford. In Australia the same process of population amalgamation can be seen in the Greater Wollongong area, stretching from Port Kembla to Stanwell Park.

On the whole the dependence of the cotton industry on overseas sources for its supplies of raw materials, and overseas markets for the dispersal of its manufactured products necessitates a great amount of commercial organisation and financing. Manchester, as the former centre of the industry and the focus of routes, assumed the functions of bank and warehouse, thus becoming the commercial centre of the industry.

Steel manufacture. These works are situated at Irlam near the Manchester Ship Canal. As there are no local supplies, iron ores are imported from abroad and treated in a modern plant of coke ovens, blast furnaces, steel works and rolling mills. From these, pig iron and heavier steel products are exported directly, but most of them pass to British engineering firms to be made up into engineering products, including textile and electrical machinery, locomotives and oil pipe lines. There is a considerable export trade in these through the Ship Canal and Liverpool.

Cotton-spinning and dyeing. These industrial undertakings are concentrated on the south side of the Rossendale uplands and extend crescent-like in a girdle of towns along the foot of the hills around Manchester, from Bolton through Bury and Rochdale and then southward to Oldham and Stockport. Within a radius of 18 miles of Manchester are located over 80 per cent of the spindles of the industry. Their particular localisation here was determined in large measure by the original need for a moist atmosphere (provided by the high humidity in the Irwell pocket), the adjacent coalfield, the supplies of soft water and proximity to the *entrepôt* of Manchester. There is a certain specialisation within this region, e.g. Bolton concentrates on spinning fine yarns from Egyptian cotton, while Oldham, with a greater output of yarn than Bolton, is occupied with coarser types.

Water supplies have also assisted in the establishment of dyeing industries here, the chemicals coming from the middle Mersey factories. Bolton, Bury and Rochdale are noted for this special processing. Papermaking, where water figures again, together with esparto grass and wood pulp, is in this region on the slopes of the Pennines. Machinery for mills is manufactured mainly in this area in Rochdale.

Cotton-weaving, dyeing and printing of cotton fabrics. These industries are localised on the northern edge of the Rossendale upland overlooking and in the valley of the Ribble, in a belt running from Preston through Blackburn, Accrington and Burnley to Colne. By way of contrast, the weaving industry is far more widespread than the spinning and employs more people. Historical factors which are said to have aided the placing of weaving here included the migration of weaving masters to the Rossendale slopes, and the slower development of weaving machinery, as contrasted with hand looms. Accordingly there was less likelihood of movement from the old weaving villages down to the coalfields factories.

There is some specialisation within this weaving region. Preston ranks high for the production of fine cloths (shirtings), while Burnley concentrates on cheap cloths and Blackburn on both coarse and fine materials. Accrington is the principal centre for calico printing as well as for mill machinery.

Glass manufacturing and copper refineries. The main requirements for the making of glass are supplies of silica (generally in the form of sand) and chemicals such as potash or soda from the heavy chemicals industries. Actual production involves the heating of these in a furnace, with subsequent fashioning by rolling or moulds. So it is that the bringing together of Mersey sands and the chemicals from the salt mines of Cheshire at St Helens has led to the establishment of glass making (especially of bottles) on a large scale. The products find a ready market both in local industry and overseas.

Plants for smelting and refining copper are also located at St Helens, as well as Widnes, both of which were formerly important in the ore-smelting industry. The actual work involves the refining and

working up of imported copper bars and their change into rolled sheets and wire. There is a considerable demand for these in the industries of Lancastria, more especially those concerned with electrical machinery and cable production. Copper has a wide variety of uses because it is so easily fabricated; machinery engineering takes most supplies.

Farming areas. Farming is fairly widespread throughout Lancastria, although it is apt to be overlooked because of the intensity of industrial occupance in the province. The development and importance of agriculture here rest on

(*a*) assured markets made possible by the increasing demands for fresh food supplies for surrounding industrial centres;

(*b*) variety and suitability of soil types;

(*c*) abundant supplies of cheap fertilisers from the many chemical works of the region;

(*d*) climatic conditions made relatively mild as a result of the sheltered position.

In general the following agricultural types are significant:

(*a*) Market garden produce. Large supplies are grown by intensive farming of the drained peat mosses or bogs on the plain and marketed in the adjoining urban areas. The farms are mainly in the Mersey valley about Liverpool, as well as at Chat Moss, Ormskirk and Chester. They are distinguished by small market gardening of the horticultural type on an average area of about five acres, and produce celery, greens and vegetables.

(b) Milk, cheese and meat supply. A good milk and cheese supply is provided by cattle grasslands on the heavy clays of west Cheshire and along the Pennines. Lancashire and Cheshire are more heavily stocked than any other region in Britain and everywhere dairying is increasingly important. In the northern sections of the province general purpose Shorthorn cattle provide a very valuable meat supply.

(c) Potatoes, oats and rye. These products thrive best in the loams of West Lancashire and mid-Cheshire. Potatoes are actually the chief root crop of the whole province, and are grown in rotation with oats, grass and fodder crops for cattle. Oats form the main cereal crop for sale in neighbouring towns and districts, with the straw being used as litter. Rye is important in the south-eastern portions of Lancastria, where its straw is used for the packing of pottery exports.

(d) Grazing. The broad, windswept moors which cover the summits and steeper slopes of the Pennines and the Rossendale and Bowland uplands are used as grazing areas for hardy cross-bred general purpose sheep and for cattle. These areas supply beef to the city markets and are used for breeding cows for the dairying industry. Their sheep were responsible for the beginning of the woollen spinning and weaving industries during the sixteenth century and therefore, indirectly, for giving the native population an interest and skill in textile manufacturing.

On the whole much good agricultural land has been ruined by mining, factory fumes and reckless building programmes in the past. These hostile factors are offset to some extent by reclamation of land from the river, cheap chemical fertilisers and certain constant markets.

Water supplies. As Figure 67 shows, water supplies have their origin in the uplands to the north and east, where there is a heavy rainfall occurring on the sandstones. Where these are covered with peat bogs the rain-water is absorbed and later appears as springs forming the sources of small streams and rivers. As soft water, containing little or no lime in solution, it is of special value to the cotton textile industries which became localised in the river valleys at the foot of the upland region. Subsequently a semi-circle of towns grew up to the north and east of Manchester and not far from it. In a similar way settlement developed in the Ribble valley to the north of the Rossendale uplands.

These water supplies are very valuable for other industries, including paper manufacture, and they meet the vast domestic needs of the millions of people crowded together in the urban districts of the province.

By way of contrast, the water of the plain to the south and east of Manchester, must be pumped from underground sources. As it contains much lime it is hard water and so useless for the textile manufacturers but valuable for brewing. As a result most of the brewing centres are established on the plain at such places as Chester, Warrington, Liverpool, Salford and Manchester.

Silk, rayon and paper manufactures. (*a*) The silk industry is located south of Manchester on the slopes of the Pennines. Here are several towns like Macclesfield, Leek and Congleton, which have a long association with the silk trade. Macclesfield in particular goes back to the sixteenth century. Main historical factors in localising the industry were the settling there of skilled foreign craftsmen to the woollen trades and subsequently, the adaptation of cotton machinery to the making of silks. Today water supplies are still important as well as access to the chemical industries of the plain, for purposes of bleaching, fine dyeing and mercerising.

(*b*) Rayon (artificial silk) is a textile material which has become of real importance for fabric manufacture in the last 25 years. Its manufacture in silk centres (e.g. Macclesfield) has largely been determined by the general needs for silk manufacture, i.e. water, chemicals and transport, except that it needs imported

wood-pulp as a basic raw material and sulphur. In recent times a greater variety of rayon fabrics has been made possible by mixture with spun silk, worsteds, wool and cotton. It is the secondary process that is prominent in Lancastria, since proximity to cotton fabric sources naturally helps the development of such a type of manufacturing. Rayon-weaving is also carried on about Liverpool.

(*c*) Paper-making requires plenty of soft water, adequate transport to handle the chief raw material of wood pulp, and accessibility to large markets. These demands are met in Lancastria in the Pennine valleys of southern Lancastria, which are able to supply the remainder of the province with quantities of cheap paper such as newsprint. Finer quality paper is produced from cotton waste and rags, a process in which purity of water is of importance, and one capable of being met in these areas. Another important source of paper-making in Lancastria is about the northern flanks of the Rossendale uplands, using Preston as a port.

Recreational activities. These are mainly on the coast, although of course, there are numerous minor centres. But the seaside has a special and traditional attraction for millions of British workers living in the hinterland. Most of them spend their annual holidays in such places and not a few retire there. Blackpool is possibly the most famous and is characteristic of all these resorts in being a town of hotels, apartment houses, picture theatres, amusement piers and swimming pools. In short, their main purpose is to provide amusement and relaxation.

In the map surveys of the Hunter valley and Lancastria it was shown that each of these major regions was capable of sub-division into sub-regions on the basis of landforms, land use and human activities. Each sub-region is characterized by some geographical feature which tends to give it a geographic personality and thus distinguishes it from the adjoining sub-regions. In the same way the dominant activity of a major region may also imprint on it a stamp which marks it off from other major regions. This is well illustrated throughout the preceding work by such regions (and terms used to describe them) as the Lancashire cotton area; the Yorkshire woollens area. In the companion volume, *The Rural Scene*, we speak of the New England region (both of the U.S.A. and New South Wales); the corn belt; the cotton belt; the wool-wheat belt of New South Wales and so on. In this present book there are the city regions of Sydney, London and New York.

If we take either the Lancashire region or the Hunter valley and note the various activities in it we see that these are to a great extent dependent on each other. There is thus shown an interdependence among the various activities within the region: this the geographer describes as integration.

All activities in modern technologically advanced communities are in some way dependent on other activities, and the measure of this interdependence is in part the measure of the extent of the integration of activities in any region. A good way to show this is to draw a series of circles scattered widely over a large page to represent the various sub-regional activities, and then to draw lines linking those circles whenever you can see a link or tie between them. Thus coal, in Lancashire, (Figure 67) is used directly by the areas numbered 2, 3, 4, 5, 6, 7, 8 and 11, so you would draw lines from your circle to each of those listed. When you do this for all the circles you will have a very intricate and complicated diagram to illustrate, in part, the complex integration within the Lancashire region.

A similar diagram for the Hunter valley region (based on Figure 60) will show a much simpler pattern having very loose ties in the upper portion of the valley and much stronger ones between the coalfields and the adjoining areas. Here, too, Newcastle emerges as a strong nodal point for the lower valley areas.

Examination of the rail and road maps will show that these act as integrating factors within the regions, as well as tending to emphasise the focusing of the activities towards the nodal points, such as the seaports or marketing centres, as with Newcastle in the Hunter valley or Manchester in Lancastria. It will be noticed that in most instances each of the smaller sub-regions tends to have a focal point, as for example, with Muswellbrook, Maitland, Cessnock and Merriwa in the Hunter valley, and with Liverpool, Bolton, Blackburn, Wigan and Preston in Lancastria.

In addition to the obvious integrating factors of transport routes and producing activities, there is also a group of less tangible but real factors operating within each region and sub-region. Some of these are as follows:

(*a*) The nodal centre tends to become a marketing, trading and shopping centre for the region.

(*b*) The major nodal centres (e.g. Newcastle in the Hunter valley and Manchester or Liverpool in Lancastria) act as focal points for the distribution of consumer goods. They are the wholesale supply centres for great areas of surrounding country. They are also financial and administrative centres for their region.

(*c*) Because of their position as nodal points and their city character they are also cultural centres for the region. In them are found church headquarters, large high schools, colleges, and universities to which the whole region sends its students, the main newspapers which reflect the opinions and mould the thought (especially the political thought) of the region, and the principal radio stations which broadcast to the region.

(*d*) Their position and city character cause a concentration of regional service activities in them, e.g. electric power from large central power stations such as Zara Street at Newcastle, and water-supply control.

In the field of sport we often see a strong regional integrating factor. This is very well shown in the case of Lancashire. It is also present in the Lower Hunter valley.

It is thus obvious that the term "integration of activities within a region" is a real one with a wide meaning. It results in each major region's acquiring a personality and its people tending to think regionally on issues affecting their lives. In order to obtain visible evidence of this you might well make a regional study in terms of the above of the particular area where you live.

13

CONSERVATION OF NATURAL RESOURCES

When we speak of the conservation of natural resources we mean taking of measures which will prevent the destruction or deterioration of the natural wealth of a country. It is an attempt to substitute the intelligent use of the resources of water, soils, forests, grasslands, minerals and wild life for wasteful and destructive exploitation of these assets. In *The Rural Scene* the bad results of the latter are described in several instances, e.g. the corn belt of the United States of America and the wheat belt of New South Wales. Such effects should impress us with the fact that while it is necessary to use the natural resources at hand in order to live, in past history our utilisation has all too frequently been injurious and destructive. Hence it is important that conservation should aim at preserving resources for our own use and ensuring that they will be available for future generations.

Examples of the destruction of natural resources. Some of these are

(*a*) the removal of resources by lumbering, e.g. the original cedar timbers of New South Wales; by mining, e.g. the early goldfields of Victoria; by hunting and fishing, e.g. the indiscriminate slaughter of the koala in Australia;

(*b*) the removal of one resource to make room for another, as in the clearing of forests and woodlands for agriculture, e.g. the coastal and mid-western plains of New South Wales; or in burning grass and brush to clear for plantations or to drive out game, a common practice among the natives of the Pacific islands;

(*c*) damage through misuse, as with soil erosion from unwise farming methods, e.g. the Dust Bowl of the United States; or the pollution of streams in industrial areas of large cities.

Quite often the damage to one resource may result in the unexpected destruction of others. Forest removal by lumbering of an unscientific character may hasten soil erosion and choke streams, thus increasing flood hazards, e.g. the coastal river valleys of New South Wales.

Carelessness, especially in the use of fire, can have far-reaching results. Forest fires mean loss of valuable timber plus subsequent erosion and stream silting. Several tragic bush fires in Gippsland, Victoria, in recent years have had just this effect.

Historical aspects. This problem of destruction of natural resources is a very old one and still exists among both the shifting native agriculturalists of African jungles and peoples of advanced technological skills. In fact, in the latter case, the drive for utilisation with superior means has evolved more and quicker methods of destruction, e.g. the tractor-drawn steel plough.

Among important factors responsible for this drive may be numbered the great growth in the world population itself, from something like 600 million people in the eighteenth century to over 2,000 million in the mid-twentieth century.

This phenomenal increase has been accompanied by

(*a*) a greater and more intensive use of resources in the older settled lands;

(*b*) an expansion into the newer lands of the Americas, Africa, and Australasia, where was originally a great abundance of untapped natural resources.

It was this very abundance which resulted in a large measure in the rapid destruction of the natural resources of forests, minerals and soils all too obvious in these newer settled lands. There was a temptation not to be concerned with conservation, so that there developed a carelessness and an attitude of "get-rich-quick" on the part of farmers and governments of the day, who rarely saw beyond their own life span in the matter of the use of natural resources. This was especially evident in the colonial history of our own country.

The result has been that serious-thinking farmers, industrialists, scientists and statesmen of the twentieth century have been faced with events and conditions which make an urgent demand to look to the future. They feel that determined efforts must be made now to halt the present destructive relationship between man and his environment before the resources of the earth are reduced to a point where they will no longer support the world's population. In spite of tremendous achievements like that of the Tennessee Valley Authority in the United States, many experts assert that that point has been reached already and passed!

Let us turn to a consideration of some of the modern concepts and methods of conservation.

The meaning of conservation. Conservation as now understood by the specialists in the various fields aims broadly at the following:

(*a*) the correct and most economic use of natural resources which are expendable, e.g. minerals;

(*b*) the substitution of sound methods of control in place of unrestricted and unguided use of those resources which are expendable but capable of being restored or preserved, e.g. forests and soils;

(*c*) the use, where possible, of inexhaustible resources in place of those which are expendable and non-restorable, e.g. water power for generating electricity in place of coal and oil, or on the other hand, plastics for metals;

(*d*) the correct use of farmlands so that there will always be an adequate supply of foodstuffs and plant raw materials.

Here it should be noted that soil conservation includes the use of suitable crops and crop rotation as a farming practice as well as mere contour ploughing, strip-cropping and the control of drainage by grassed channels (*The Rural Scene*).

Methods of conservation. Forests. Here we have one of the world's great conservation problems. It has been created not only by the ruthless destruction of timber in lumbering operations, but by careless clearing and ringbarking for agricultural and grazing purposes as well as the devastating effects of forest fires.

Most countries of the world are at present using up their timber resources at a far greater rate than nature can replace them. Scandinavian and Russian regions are exceptions because of their enormous softwood forests, while a few countries like Germany and Japan practise re-afforestation on a scale sufficient to replace the cut timber. On the other hand, most countries, though following some conservation programme and re-planting trees, lag far behind in replenishing, or even in using existing supplies economically.

Modern methods which are usually suggested and put into operation for forest and timber conservation include:

1. Preservation, i.e. the control of lumbering so that sufficient timber is always left to ensure natural re-growth. Such practices are generally employed in most countries today, more especially in Europe.

This practice, which is now adopted by Australian Government forestry departments, aims at keeping the annual cut of timber less than the amount grown by the forest. Every tree in a forest puts on a certain amount of timber increase each year; by careful observation and calculation it is possible to estimate the total amount of timber increase in any forest area. When this is known it is a simple matter to keep the amount cut below this figure.

Another aspect of this preservation is to help the natural regeneration of trees within the forest areas. For establishing new trees natural regeneration is much more satisfactory than planting. The trees are allowed to seed and the seedlings are thinned out to the desired spacing and then protected as far as is possible from pests (such as the rabbit) and destruction by fire. By this method of control young trees are always replacing those removed by lumbering.

2. Fire control, i.e. adequate control and protection against the devastating effects of forest fires. Here there is not only an actual loss in timber and plant life but a resultant exposure of young growth and consequent killing off by winds, frosts, etc. There is also a diminution of bird and other wild life, water and wind erosion on the exposed top-soil, and destruction of beauty spots. Elaborate services of aerial spotting and trained rangers are provided in many great forest regions today, particularly in the United States. The building of access roads in forest areas to enable fires to be quickly attacked and localised is an important feature of fire control.

3. Re-afforestation, i.e. the re-planting of suitable forest trees in selected areas. This may take two forms. First there is the practice of restoration or the planting of natural species of trees in suitable places, more particularly on deforested watersheds and catchment areas. Secondly, there is "beneficiation", or the planting of exotic species where there is a shortage and where climate and soils will permit. In Australia both these methods are being attempted, but the slow growth of eucalypts and the difficulty of establishing softwoods on a large scale have made progress difficult.

4. Administration, i.e. government control of forests. This refers not only to the proper supervision of forest resources by skilled State experts, but the establishment of new timber areas along the lines suggested above. Such administration is typical of most countries today. In Australia each State has its own special department for forest administration and men are recruited for special training. Some feel that insufficient attention and funds are paid to it yet.

5. Milling, i.e. improved cutting operations. These aim at enforcing milling operations which will reduce waste and make the best possible use of poorer timber trees (e.g. to produce masonite).

6. Research, i.e. the further study of forests and timber for their most effective use. There is still a big field for research in many branches of the science of silviculture as it is known, e.g. the growth and use of timbers and the study and control of diseases. In Australia the growth of cedar, a most valuable and beautiful cabinet timber, is still hampered by destructive diseases. Such research as has been outlined above might well be included in the next aspect of conservation of timbers.

7. Substitutes, i.e. the substitution of other plant products for timber in various constructional works. In recent years there have been great advances made in the manufacture and use of different types of pulpwoods for boards. Masonite, a wide variety of veneers, and the use of sugar-cane fibre or caneite have done

much to save forest timber in such urgent tasks as housing and furniture making.

Grasslands. These important natural resources are now receiving attention in the study of conservation problems, both in their relation to pastoral agriculture and in the preservation of soil cover. As a result the following are some of the important controls adopted:

1. Prevention of overgrazing. This is a difficult task for government authorities as it involves so many properties belonging to private individuals. The general procedure is to offer free advice and suggestions by experts and give wide publicity to the possible losses which may be entailed in the future on overgrazed lands. Educational programmes would appear to be having some success in Australian rural areas, for many farmers take it upon themselves voluntarily to exercise more care. An extreme measure is to introduce legislation compelling "retirement" of certain lands. This step was taken in the United States in a desperate attempt to rehabilitate the cattle areas of its badly eroded western cattle regions. Along with such measures there may also go the next methods to be mentioned.

2. Restriction of cultivation. This can be suggested or even enforced, more especially on types of marginal lands as mentioned above. The tragedy of much of the notorious Dust Bowl can be attributed to the wholesale opening up of natural grasslands for wheat-farming in central and western United States of America and their subsequent exploitation over the years. Similar conditions have come to pass on a smaller scale in parts of our own middle-western New South Wales (Hillston area).

3. Improvements to grasses. These improvements may take the form of re-seeding and top-dressing of areas or of using irrigation where practicable to aid the growth of natural and introduced pastures. The former poses the problem of finance for the farmer, but the latter can be achieved by government schemes like those in the Murray Valley.

4. Control of pests. Here the rabbit is the greatest challenge to Australian pastoralists. Various remedies have been adopted, but so far no really universal remedy has been found, though myxomatosis shows promise.

Water. The conservation and proper use of water supplies are most important in a country like Australia, where much of the continent has a relatively low rainfall. It is easy to appreciate that such wisdom has far-reaching effects on other forms of conservation, and in turn is affected by proper conservation in other fields, especially with forests and soils.

The main method of conservation of water is the building of dams on all streams where catchment areas, rainfall and topography are suitable for storing water. Such a policy is being pursued fairly vigorously in all Australian States today. In N.S.W. special attention is being given to both coastal and inland regions, e.g. the Moree area and the Hunter Valley.

The goals behind such constructions are as follows:

(*a*) The irrigation of food and fodder crops, thus to increase the farming potentialities of adjacent lands, e.g. the Murray Irrigation Area of New South Wales, and the various schemes of Victoria.

The use of conserved water for irrigating fruit orchards in Australia has reached its limit. The present irrigated orchards and vineyards can supply the local market and have difficulty in disposing of their products overseas. This does not favour the argument that the world cannot feed its people. Conservation schemes now being built or planned therefore envisage other uses for the water. Some of these are

(*i*) the stabilisation of the wool-sheep industry where possible by providing water supplies for stock in areas supplied by dammed rivers and their distributaries;

(*ii*) the gradual extension of irrigation of various fodder crops to allow for the substitution of more intensive forms of farming in suitable areas.

Examples are in the fat-lamb and dairying activities now found west of Albury in the Berriquin Irrigation District and the pig-raising, dairying and fat-lamb farming in the lower Goulburn Valley. In each case these new industries have replaced mere stock-grazing or wheat-growing; and they are producing products for which there is a ready sale overseas.

(*b*) The generation of electric power which is transferable to other areas and is usable in place of power obtained by burning coal or oil, e.g. the Waddamana and Tarraleah schemes of Tasmania, the Kiewa scheme in Victoria and the Snowy River scheme.

(*c*) Stock and domestic supplies in semi-arid lands, thereby stabilising grazing in those areas, e.g. the far western areas of the United States cattle regions and the lower Darling River in New South Wales. Artesian and tank systems in the drier pastoral sections of Queensland are good examples of this type of water conservation.

(*d*) Prevention of pollution and consequent preservation of fish life in streams. Such steps are usually adopted in the catchment areas of important dams, e.g. the Warragamba, New South Wales, or those rivers where the raising of fish like trout is carried on.

(*e*) Improvement of inland transportation. In making streams more navigable, canalisation has reached a high degree of efficiency in many European countries and in the United States. In Australia the Murray-Darling system has several schemes in oper-

ation or planned to improve transport along its waters as well as to control flood movements. The usual method adopted is that of a series of weirs and locks.

Native flora. Everyone recognises the necessity for adequate protection of the beautiful and scientifically significant native plants and wildflowers of a country, especially those of one's own land. In Australia careless treatment of these in the past has led to complete extinction of some species, while others have become very rare. A keen desire to retain them and a good knowledge of their special characteristics is the only safe provision for their future. Legislation will never be entirely successful in an atmosphere of apathy and ignorance. While it is generally appreciated that certain laws covering the protection of wildflowers are probably desirable in our society since it cannot be hoped that the whole population will respond to proper education in this regard, it is also recognised that legislation without education is useless. Apart from work done in schools by teachers, the public can be urged to help preserve wildflowers and plants by refraining from picking protected types in any bush lands, learning to recognise protracted plants and finding out something about their habitats, by knowing the general provisions of protection acts, by refraining from purchasing any wildflowers, and by interesting children in the cultivation of native plants in their own small wildflower gardens.

Native fauna. Here we are concerned in the main with preservation and protection of native mammals, birds and reptiles.

The major reason for such action is bound up with what is usually termed "the balance of nature", whereby although one species may be constantly pitted against another, the comparative numbers remain almost unaltered. Native races like those of Africa, India, America and Australia have been killing the game of their respective countries for centuries, yet the fauna has not suffered. Since the advent of civilised man and his unchecked commercialisation of fauna—elephants for the ivory, bison for hides and sport—the numbers of these and other species have been so reduced (some being on the verge of extinction, e.g. our koala) that laws have had to be passed to bring man to his senses and to enable the animals concerned to re-establish themselves. Thus one of our first faunal problems is the better protection and development of our native fauna. Others include the better education of the public regarding their aesthetic and economical value, the economic and scientific utilisation of such of our faunal resources as might be available, and finally the introduction and acclimatisation of foreign species into Australia.

The solutions to these problems are similar to those relating to the native flora. Legislation can be enforced not only to keep out noxious species but to protect what we have because of its unique scientific, aesthetic and economic value, e.g. the quail, which are valuable friends of farmers in farming and grazing lands because of their control of the seeds of weeds, and insects. Establishment of sanctuaries with types which are rare and which we hope to preserve is a further method of conservation, especially in these days of increasing settlement of an urban character. But the stimulation of a nature consciousness amongst our people, more especially our children, is probably the most important means of protection. This can be achieved in the main in our schools by means of a wider interest in and love of nature, with particular stress upon economic natural history. Already much is being done in this direction by broadcasts to primary and secondary schools along with museum exhibits and lectures. Not until we have taught people something of the value of fauna can we hope to preserve and use our fauna properly.

Minerals. These may be regarded as a definitely expendable and exhaustible resource, so much so that some are disappearing much faster than others due to smaller supplies and ever-widening uses, e.g. copper, tin, oil and iron. Of these minerals the following are particularly significant and conservation is important.

1. Coal. There are large reserves throughout the world but it is estimated that at the present rate of consumption most of our coal resources will have been used in the next thousand years. Hence conservation methods should aim at

(*a*) Reducing waste by improper mining methods, since some of these now in use leave more coal underground than is brought to the surface. Newer methods are being introduced especially since the invention of highly mechanised equipment. One valuable technique being used is that of gasification of coal at the face, especially in difficult seams and the worked-over areas. This has not yet been done in Australia.

(*b*) Improvements in the efficiency of coal burning furnaces. Although much has been done in this field, too much unconsumed coal still goes up the chimney as smoke and soot.

(*c*) Improvements in coking plants and the efficiency of blast furnaces. Much has been done here, but it still takes about as much coal to smelt a ton of iron ore as it did in 1920, though much less than in 1870.

(*d*) Making use of poorer grades of coal, especially for generating electricity. This has been achieved successfully at Yallourn in Victoria.

(*e*) Improving the efficiency of the steam engine and substituting water power where possible for steam power, especially for generating electric power for factories and traction. Plans for the development of the Snowy River visualise great steps forward in this regard in south-east Australia.

2. Iron. This is a basic commodity in modern industry, but it has a limited life and there are not unlimited reserves. Conservation of iron ore can be achieved by the following means:

(*a*) Introduction of more efficient smelters so as to make use of low-grade ores. Firms in England and Germany have already made attempts in this direction.

(*b*) Widespread substitution of plastics and other products for iron goods, e.g. tiles for roofing and guttering; carboard for containers for food; plastics in motor-car construction.

(*c*) Avoidance of waste, especially of used iron tins and scrap. Already there has been an increasing use of scrap iron. It has been estimated that nearly 50 per cent of modern steel is made from scrap as against 5 per cent before World War I.

(*d*) Increased substitution of water transport for rail and road transport wherever possible, since water transport does not need so much steel.

3. Other metals: Tin, zinc, lead, copper, aluminium, magnesium. Many of these are already in short supply and are vital in our modern world, e.g. copper for electric power lines. Hence to conserve these important resources the following steps are needed:

(*a*) More careful and restricted use of these metals.

(*b*) Extraction of these, and other metals from sea water, at present possible but very costly.

(*c*) Substitution of plant-produced products for metals where at all possible, e.g. plywoods, plastics from resins.

(*d*) Continued and widened recovery of secondary metal, i.e. re-smelting old scrap and incorporating it with fresh metal (nearly 50 per cent of the copper used in U.S.A. is secondary copper).

BIBLIOGRAPHY

This is not intended to be either a full bibliography of the books and pamphlets the authors used or a complete geographical bibliography on each of the sub-divisions named. Rather is it a guide to useful publications which might form the nucleus of a school library, or which the student might consult to obtain a wider and fuller knowledge of his chosen subject.

General Geography

Finch and Trewartha, *Elements of Geography,* 1950; Davis, *The Earth and Man,* 1948; James Preston, *An Outline of Geography,* 1945; Stembridge, *The World,* 1947; Huntingdon and Cushing, *Principles of Human Geography,* 1934; White and Renner, *Human Geography,* 1948; Rudmose Brown, *Principles of Economic Geography,* 1931; MacFarlane, *Economic Geography,* 1946; Whitbeck and Finch, *Economic Geography,* 1941; Smith and Phillips, *Industrial and Commercial Geography,* 1946; Dickensen, *City Regions and Regionalism,* 1947; Jones and Darkenwald, *Economic Geography,* 1945; Renner, *Global Geography,* 1946; Zimmermann, *World Resources and Industries,* 1933; Daryll Ford, *Habitat, Economy and Society,* 1946.

Australia

C.S.I.R.O., *The Australian Environment,* 1950; Griffith Taylor, *Australia,* 1940; Wood, *Australia, its Resources and Development,* 1947; Ford and MacInnes, *Australia and the Pacific,* 1951; Holmes and Andrews, *Descriptive Geography for Secondary Schools,* 1936; Wadham and Wood, *Land Utilization in Australia,* 1950; Commonwealth Office of Education, *Australia's Resources and Their Development,* 1948; Australian National Publicity Association, *Walkabout Magazine (Monthly), Australia (Official Handbook),* 1950; Holmes, *The Murray Valley,* 1948; Holmes, *Soil Erosion in Australia and New Zealand,* 1946; *The Australian Geographer.*

Other Countries and Continents

White and Foscue, *A Regional Geography of Anglo-America,* 1948; Smith and Phillips, *North America,* 1946; Pickles, *North America,* 1945; Jones and Bryan, *North America,* 1948; Stamp and Beaver, *The British Isles,* 1946; Wilfred Smith *An Economic Geography of Great Britain,* 1950; Cundall, *Western Europe,* 1932; Stamp, *Asia,* 1939; Cressey, *Asia's Lands and Peoples,* 1944; Cressey, *China's Economic Foundations,* 1934; Trewartha, *Japan,* 1945; Suggate, *Africa,* 1936; Fitzgerald, *Africa,* 1948; Suggate, ***Australia and New Zealand,*** 1931; Lane and Dell, *Asia, Australia and New Zealand,* 1948; Demangeon, *The British Isles,* 1945; Mitchell, *Industrialization of the Western Pacific,* 1946; James, *Latin America,* 1942. Magazines and pamphlets on geographical topics are published by Government departments in Australia and overseas. Sets of recognised geographic magazines such as *Economic Geography, Geography, National Geographic Magazine* are available.

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